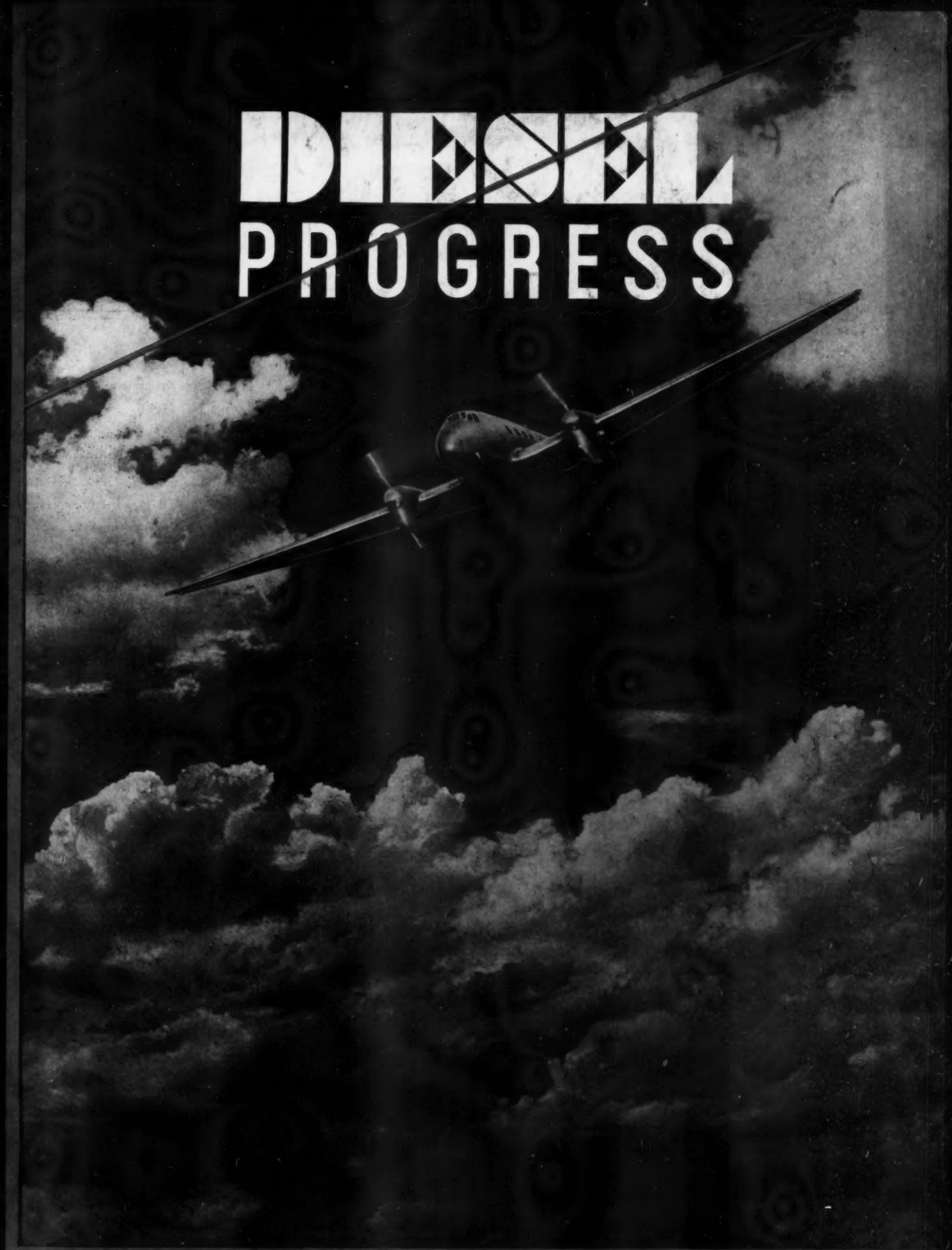
DIESEL PROGRESS

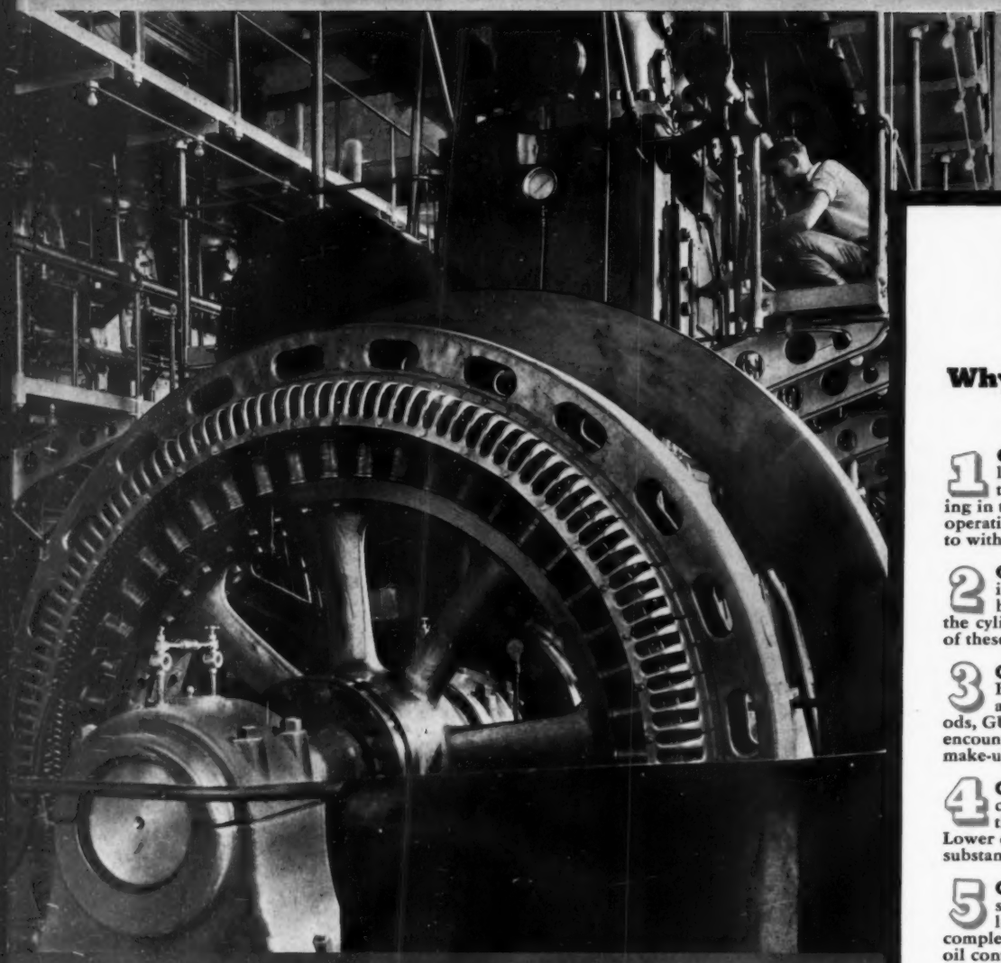
IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR



AUGUST, 1936 CIRCULATION OF THIS ISSUE—IN EXCESS OF 10,500 COPIES 25c

USE GULF PARVIS OIL

for low Diesel operating costs!



Gulf Parvis Oils are helping operators of many leading Diesel plants, such as the one shown above, make substantial reductions in over-all operating costs.

5 Reasons

Why Gulf PARVIS OILS Reduce Diesel Operating Costs

1 **GULF PARVIS OILS** are especially manufactured for lubrication of Diesel engines. High temperatures, contamination with fuel and moisture and constant churning in the presence of air—all encountered in Diesel engine operation—necessitate the use of an oil especially prepared to withstand these conditions.

2 **GULF PARVIS OILS** insure minimum wear of cylinders, pistons and bearings. The tough film provided by GULF PARVIS OILS is not readily removed from the cylinder walls and pistons, insuring proper lubrication of these parts at all times.

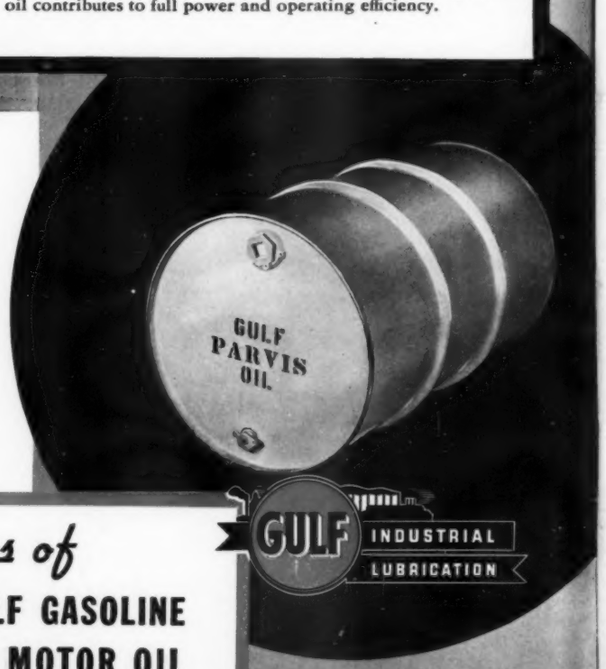
3 **GULF PARVIS OILS** insure minimum consumption. Because they are made from specially selected crudes and manufactured by the most modern refining methods, GULF PARVIS OILS withstand the high temperatures encountered in Diesel engine operation. A minimum of make-up oil is required.

4 **GULF PARVIS OILS** reduce operating costs. Because of the stability and high lubricating quality of these oils, wear and repair expense are minimized. Lower oil consumption and lower maintenance costs reflect substantial savings in over-all operating costs.

5 **GULF PARVIS OILS** are low in carbon content—a safeguard against carbon deposits resulting from the lubricating oil. With good atomization of fuel and complete combustion, rings retain their freedom. Thus, the oil contributes to full power and operating efficiency.

LEADING Diesel plants have established this fact: Over-all operating costs usually have a direct relationship to the efficiency of lubrication. With Gulf Parvis Oil in service, many plant operators are reporting the lowest operating costs in their experience.

Gulf Parvis Oil stands up over long periods of service—costs less to use in the long run. This quality lubricant has been scientifically manufactured to provide maximum protection for cylinders, pistons and bearings—with low consumption. It will help you keep maintenance costs at a low level.



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GULF REFINING COMPANY
GENERAL OFFICES: GULF BUILDING, PITTSBURGH, PA.

Makers of
THAT GOOD GULF GASOLINE AND GULFLUBE MOTOR OIL

GULF INDUSTRIAL LUBRICATION

DIESEL PROGRESS for August, 1936. Volume II, No. 8. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at Brooklyn, New York, authorized May 14, 1935. Subscription rates: United States and Pan American countries $3.00, Canada and all other countries $5.00 per year. Single copy price 25 cents in U.S.A., 50 cents for all other countries.

. . . Leading engine builders rely upon our many years of experience when fine quality and accurate finish are necessary.

ERIE

crankshafts again selected for the three 750 hp., 4-cycle, 6-cylinder, 17½"x25" McIntosh & Seymour Engines for the Cushing, Oklahoma, municipal Diesel plant.

CRANKSHAFTS

Rough and finished connecting rods, piston rods, crossheads, generator and extension shafts for all classes of stationary and marine engines. Complete facilities for prompt delivery on all major forged or cast steel elements required in the building and powering of every type of construction.

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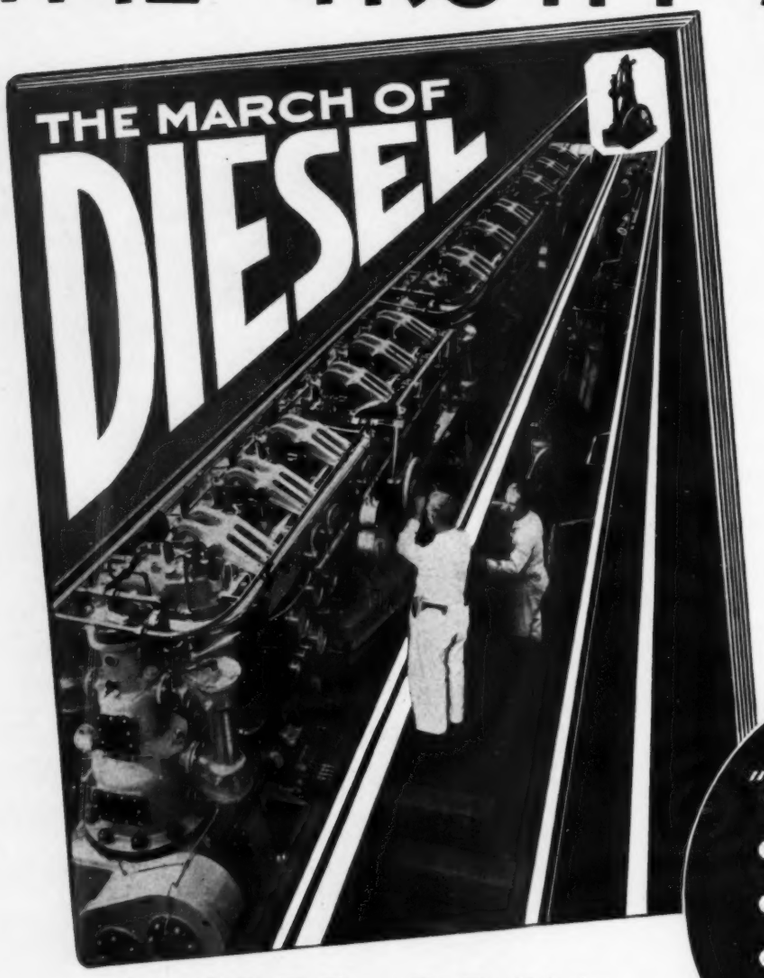

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- A Standard by which **YOU CAN JUDGE** the importance and significance of this field to the world today. . . .

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of the "March of Diesel" will be sent without cost or obligation (while supply lasts) to those men who are interested in the history, the growth, the magnitude and the future of the Diesel. . . . . .

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M-16-DPR

FINE DIESELS . . . FINE OILS

Protect THEM WITH A GOULDS HYDROIL CENTRIFUGAL PURIFIER

I'm SLUDGE *the menace*

I fought the champ. On the build-up I met bearings, cylinders, compressors and pumps . . . a bunch of pushovers—I wrecked them all. Then my manager signed for a go with Centrifugal Force in the Hydroil Bowl. That was a mistake. When I woke up I was on the dump. What's that? No, there isn't going to be any comeback—I'm through.

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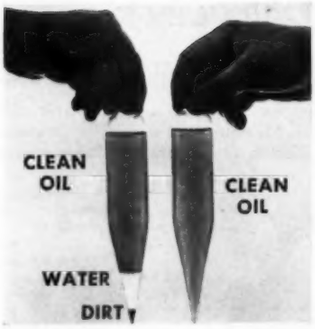

THE *"WHIZZER" PROVES HYDROILIZED OIL IS CLEAN

This unretouched photograph shows samples of used Diesel oil before (left) and after (right) purification in a Goulds Hydroil Centrifugal Purifier.

*A high speed laboratory centrifuge for testing oil samples.

IN the plants of Diesel manufacturers engineers spend countless hours designing engines remarkable for their high efficiencies . . . in the shops skilled mechanics translate these designs into parts of metal, built with split hair precision. Leading oil producers, too, have contributed to Diesel progress by developing special oils for fuel and lubrication. But when these Diesels are on your floor, when these oils are in the crankcase and fuel tanks, it is up to you to maintain high operating efficiency. Clean oil is essential to low cost, non-stop operation and clean oil can be assured only by constant centrifuging.

In the Goulds Hydroil Centrifugal Purifier centrifugal force, many thousand times greater than gravity, throws out abrasive carbon, dirt, water and other contaminating material eliminating the causes of rapid wear and plugged oil lines. Hydroilized oil may be used continuously—frequent changes or rest periods are unnecessary. Fuel oil, too, is materially improved by centrifugal purification. The removal of sand, grit and water eliminates wear on fuel pumps and valves, does away with plugged nozzles.

Follow the lead of leading Diesel operators the world over—protect your investment . . . cut your operating costs with a Goulds Hydroil.

6395

GOULDS PUMPS Inc.

SENECA FALLS N. Y.

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Specify COMPLETE ELECTRICAL EQUIPMENT *from one dependable source*

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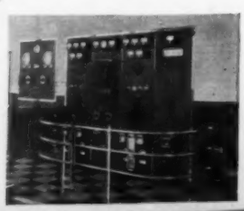
Centralize responsibility for your electrical installation in one reliable source and secure the advantages of 50 years' electrical experience by Westinghouse.

ES GENERATORS—Especially designed for lifetime operation in Diesel service, with these extra values: *Solid Steel Rotor*, to withstand severest stresses under all conditions. *Protection against Shut-downs*, insured by exclusive high frequency pre-testing. *Positive Ventilation*, for cool running and long life.

EXCITERS—Either direct-connected or belt-driven, as required.

MOTORS—With dual-protected windings, rigid cast frames, and sealed-sleeve bearings . . . for driving compressors and other auxiliaries.



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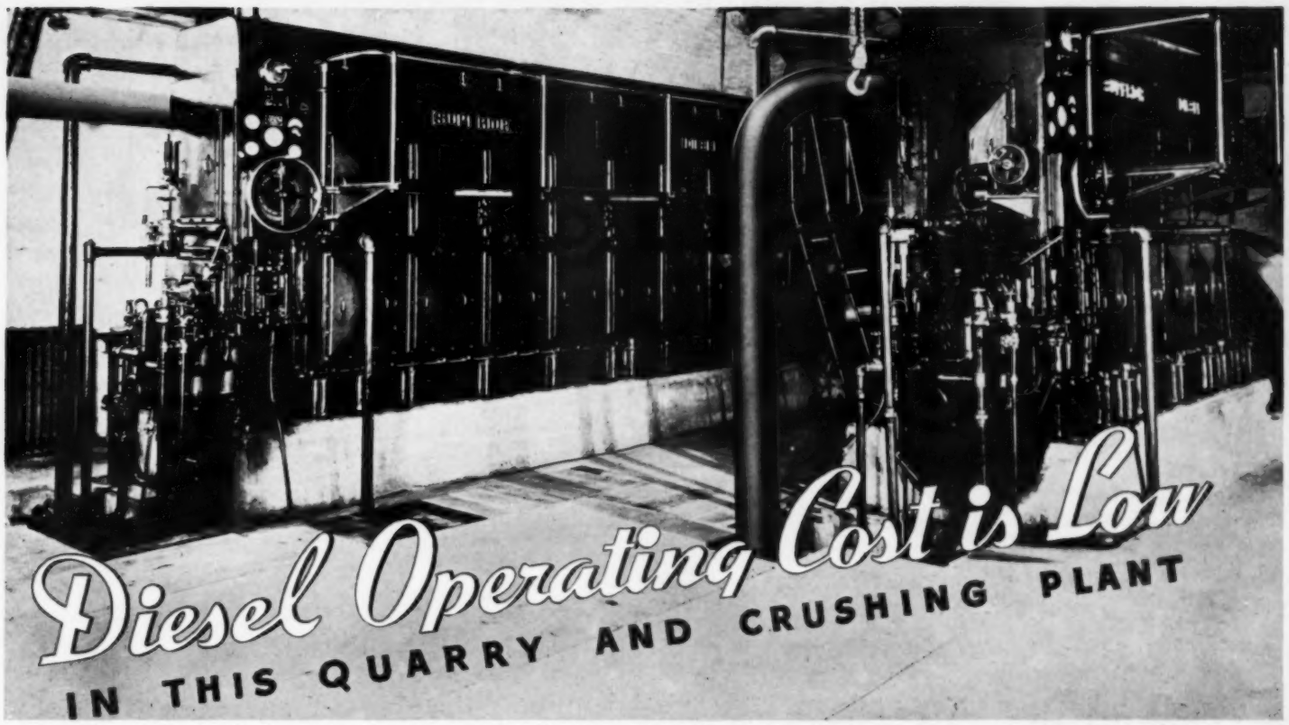


Diesel Operating Cost is Low

IN THIS QUARRY AND CRUSHING PLANT

These two Superior Diesels, one 750 H. P. and one 375 H. P., furnish power for the Ste. Genevieve Lime and Quarry Company's plant at Mosher, Missouri

With improved conditions in the building trades and a consistent demand for a chemically pure product for many manufacturing processes, this progressive company was quick to sense the competitive advantages of low power cost, which in this industry, may represent a large share of the total cost of production.

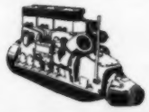
That Superior Diesels are the answer to the power problem in quarries and crushing plants is demonstrated by the fact that the Ste. Genevieve Lime and Quarry Company's actual production cost for power is 7.23 mills. This means a saving in "out of the pocket expense" of over $900 monthly, based upon production during the month of June.

That Superior Diesels meet the claims made for them is proved by the fact that the order for a second Superior Diesel was placed only a short time after the first 8-cylinder unit was installed in service and had successfully met all expectations.

If power cost is a factor in your business, we suggest a Superior Power survey by our engineers. Substantial savings are possible with astonishing small investment, because Superior Diesels are operating smoothly and efficiently in conjunction with other prime movers or purchased power where a full change-over is not immediately practicable.

Write for Bulletin No. DPA-535

Superior DIESELS



25 to 150 H. P.

THE NATIONAL - SUPERIOR COMPANY

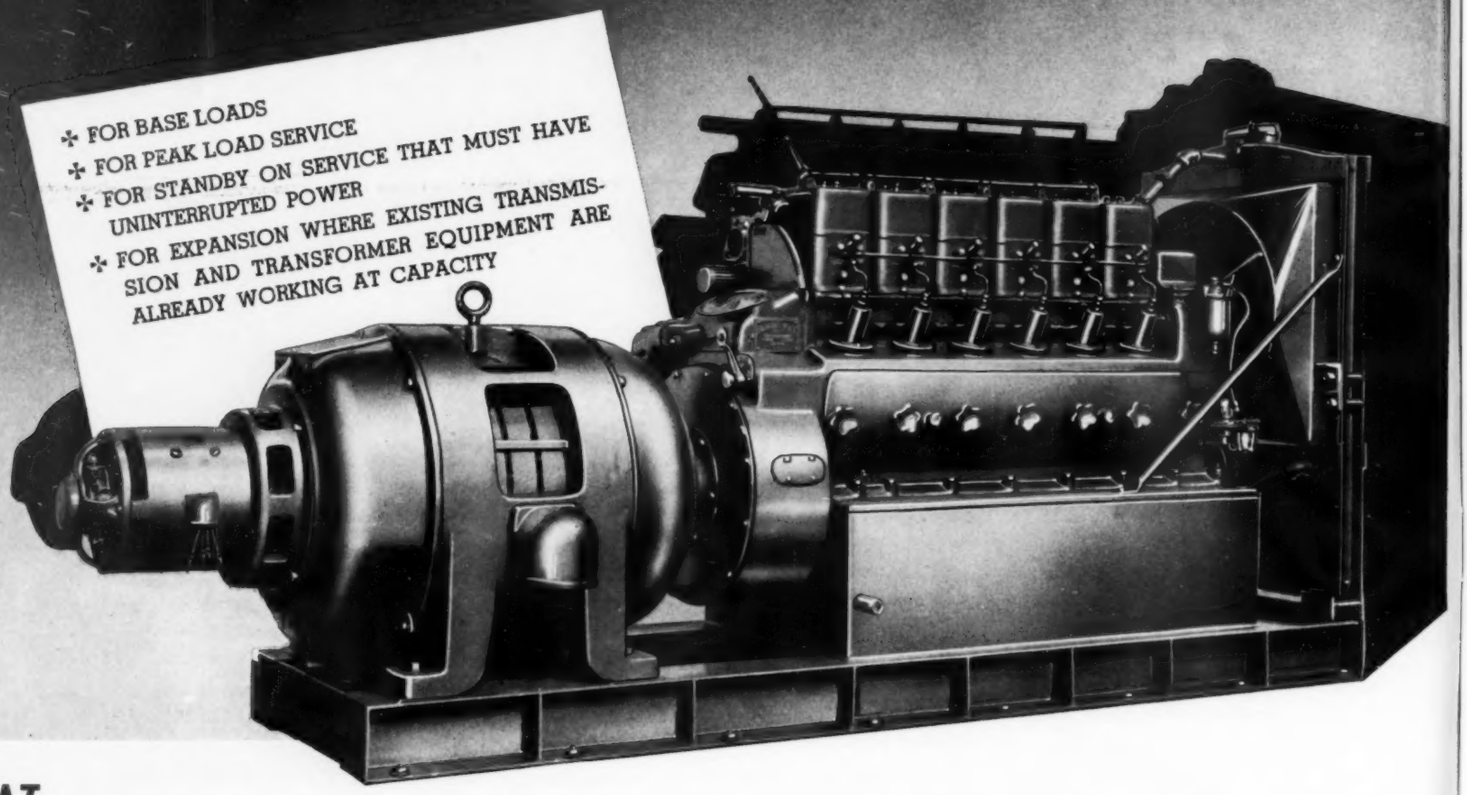
SPRINGFIELD, O. . . . LOS ANGELES, CAL.

50 to 900 H. P.

THE OTTO ENGINE WORKS . . . . PHILADELPHIA, PA.

MARKS THE SPOT

...where an F-M "36-A" Diesel Driven Generating Set Can Serve Your Business


✣ FOR BASE LOADS
✣ FOR PEAK LOAD SERVICE
✣ FOR STANDBY ON SERVICE THAT MUST HAVE UNINTERRUPTED POWER
✣ FOR EXPANSION WHERE EXISTING TRANSMISSION AND TRANSFORMER EQUIPMENT ARE ALREADY WORKING AT CAPACITY

WHICH one of these conditions applies in *your plant?* If power costs for the plant are too high ...if peak load service demands additional power ...if present equipment is already loaded to capacity—then an F-M "36-A" Diesel-driven generating set is needed on the job. These compact, powerful "packages of power" take up little space, burn cheap grades of oil, need little attention. In return, they deliver current where it's needed, *when* it's needed, at amazingly low cost. Why not find out *today* how they can serve *your* plant? For full information, address Dept. K-81, Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill. 34 branches at your service throughout the United States.

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106 YEARS OF PRECISION MANUFACTURING

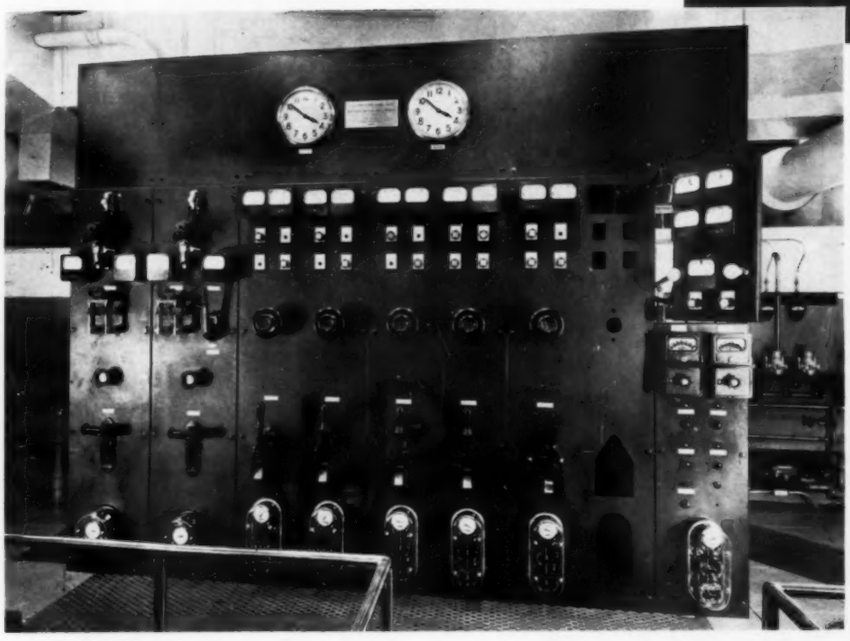
FAIRBANKS-MORSE

Diesel Engines

POWER, PUMPING AND WEIGHING EQUIPMENT

View at right shows engine room of the Namm Department Store, Brooklyn, in which four 300-hp. and one 150-hp. Worthington Diesels are installed all served by "Alnor" Exhaust Pyrometers.

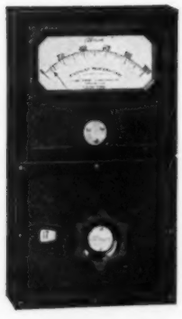
View below is the switchboard on which the two "Alnor" Type 2804 pyrometer units are mounted. These pyrometers are located at the extreme right center.



"ALNOR"

Exhaust Pyrometers

Serve Worthington Diesels at the Namm Store in Brooklyn



"Alnor" Type 2804 Pyrometer.

IN the Namm Store, one of the large department stores in Brooklyn, N. Y., Worthington Diesel engines have been installed to furnish power originally supplied by the local utility.

After careful study, an all-Diesel plant was selected in preference to steam power or part steam and part Diesel, not only because of space, but principally because of flexibility and economy.

The equipment decided upon and installed consists of four 300 h.p. and one 150 h.p. Worthington Diesel engines equipped with modern accessories, including Exhaust Pyrometers to aid in the continuous safe, economical engine performance.

As is customary with Worthington engines, "Alnor" Pyrometers were selected and furnished. Two "Alnor" Type 2804 units mounted on the switchboard (see view above) serve all four Diesels.

Whenever you install, engineer or approve Diesel installations, select or specify "Alnor" Pyrometers and be assured that the engines are provided with the most modern and dependable safeguard.

WRITE FOR COMPLETE CATALOG

ILLINOIS TESTING LABORATORIES, Inc.

423 North LaSalle Street, Chicago, Illinois

Testing Engineers and Manufacturers of "Alnor" and "Price" Pyrometers

The Products of 36 Years' Experience

Use "Alnor" Pyrometers— *The Engine X-Ray*

You can almost call them

WEAR PROOF

(Left)—Constant check-ups like these made by our field staff, provide the data that prove the wear-reducing qualities of Texaco Algol and Ursa Oils.

Thousands of check-ups like this have proved how these oils reduce wear

Reports from our field men tell of all types and sizes of Diesel engines that have not changed liners, pistons, or rings for periods of from *four* to *nine* years.

Check this performance against that which you are now getting . . .

These results are only possible because Texaco Algol and Ursa Oils are made from *special crudes* and are *especially refined* to remove the last traces of harmful carbon and sludge forming elements. What little carbon is formed, is light, fluffy, and blows out of the exhaust.

There are no deposits to stick piston rings. So you get . . .

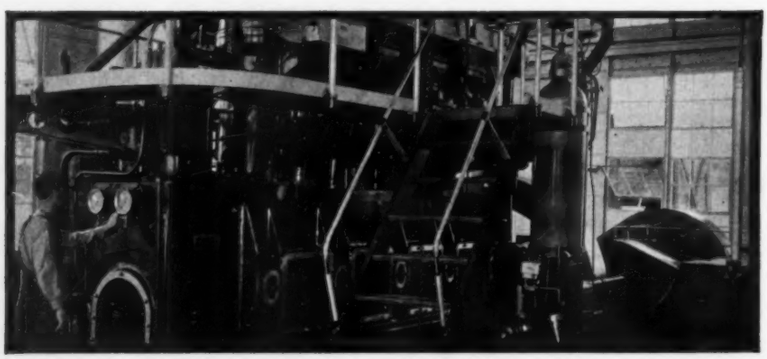
Complete piston seal—elimination of blow-by, reduced crankcase dilution—full compression—complete combustion—absolute fuel economy.

A Texaco representative will be glad to provide practical engineering service to prove the economies of these oils.

THE TEXAS COMPANY
135 East 42nd Street · New York City
Nation-wide distribution facilities assure prompt delivery

TEXACO LUBRICANTS

for all types of Diesels



(Left)—One of the many Diesels of all types and sizes owned and operated by The Texas Company. These engines provide an extensive "proving ground" where we study the needs of Diesels and prescribe oils to meet them exactly.

2 FULL YEARS

Total 92,650 Hours
3,445,000 Cu. Yards

The Enviable Performance of

19 VETERAN
TRAC-TRUKS

What counts most in hauling equipment is the *continual high average of job and yearly performance* that moves greater yardage with more profit in the long run. These ruggedly built Trac-Truks have proved their merit and versatility in all kinds of weather and variety of work conditions—including the building of reservoirs—levees—canals—dam embankments and road construction. In economy features and dependable results, these enduring performers have satisfied this discriminating buyer—The Geo. W. Condon Co.—to the extent that fleet after fleet has been added since the initial purchase was made.

Here is another fine example of Trac-Truk sustained performance and lasting endurance

Today Geo. W. Condon Company operates 44 TRAC-TRUKS

EUCLID
THE PIONEER

THE EUCLID ROAD MACHINERY CO.
CLEVELAND, OHIO U. S. A.

ATLAS

DIESEL POWERED SHOVELS

Excavate base for Clippers!

WHEN the U.S. Navy acquired the Alameda airport from which the giant Clipper ships of Pan American Airways have been winging their way over the vast expanse of the Pacific Ocean to the Philippine Islands, the Western Terminus of the Clipper ships was transferred to the San Francisco Municipal Airport on the west side of San Francisco Bay, south of the Golden Gate.

The seaplane base fill required 1,150,000 yards of material with a rock seawall 5600 feet long and 2000 feet of breakwater to give an area of 2600 by 2800 feet, all of which is to be dredged to a depth of 10 feet with a 1000 foot channel.

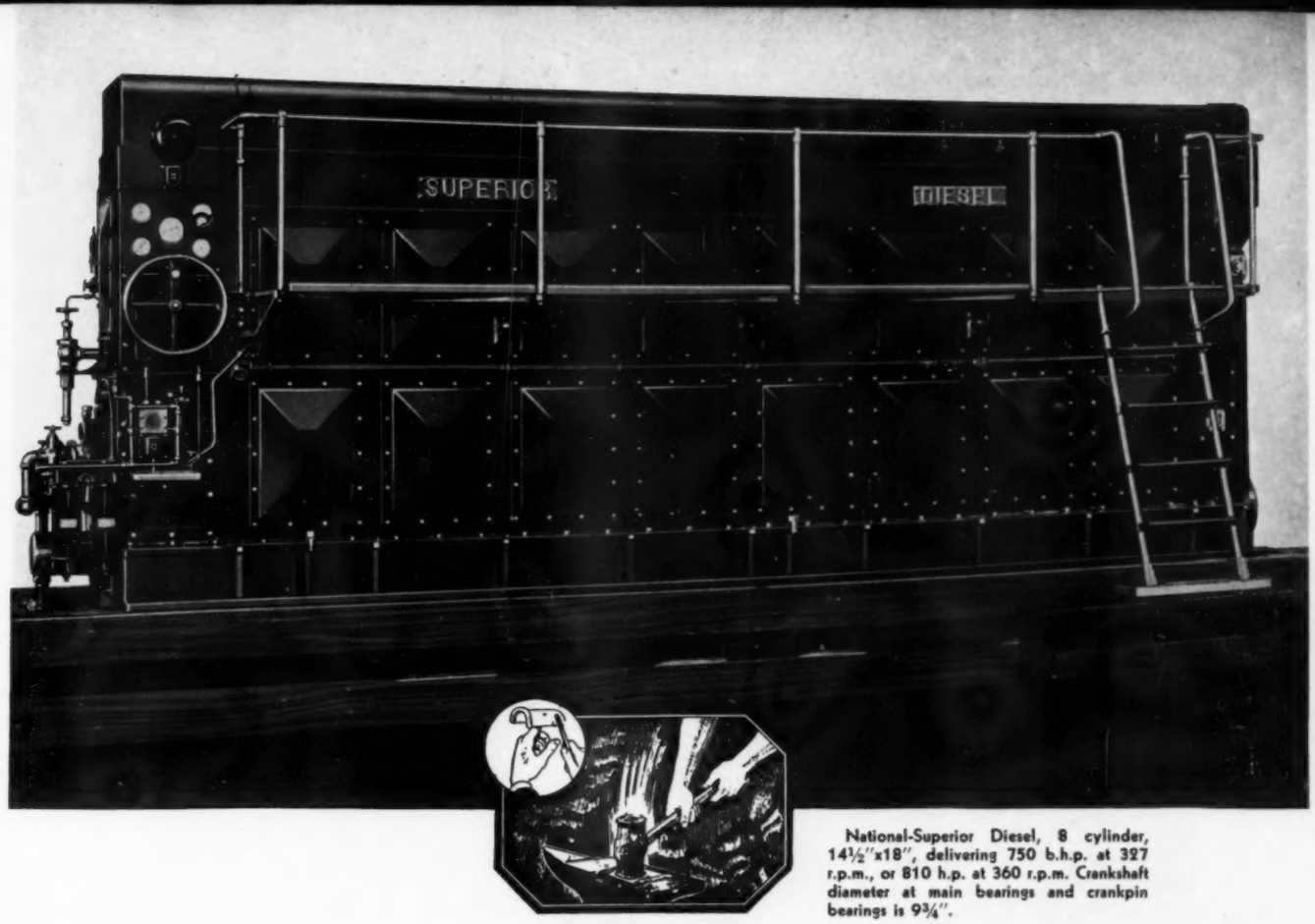
A hill of rock had to be moved from where nature left it to make the seawall and breakwater, and here, as in most other major construction projects, Atlas Diesel powered shovels have shown their mettle. On this job Granfield, Farrar & Carlin, San Francisco grading contractors, used two Atlas Diesel powered Bucyrus-Erie shovels, and excavated a total of 179,000 yards.

On nearly every major construction project you will find Atlas Diesel powered shovels and draglines, doing Herculean service in building dams, levees, roadbeds and similar excavating jobs. Atlas Diesels predominate in the excavator field—more Atlas Diesels being used in this service than the engines of all other Diesel builders combined.

When you buy a power shovel or dragline—specify an Atlas Diesel as the power unit and be sure of satisfactory power and low cost operation and maintenance. Ten different sizes of engines are available—from 45 to 275 H.P. Write for details.

ATLAS IMPERIAL DIESEL ENGINE COMPANY
OAKLAND, CALIFORNIA • MATTOON, ILLINOIS

ATLAS IMPERIAL



National-Superior Diesel, 8 cylinder, 14½"x18", delivering 750 b.h.p. at 327 r.p.m., or 810 h.p. at 360 r.p.m. Crankshaft diameter at main bearings and crankpin bearings is 9¾".

BUILT to DELIVER the GOODS

NATIONAL-SUPERIOR DIESELS are designed and built to do a specific job . . . to deliver dependable, economical power. Engines of the type shown above are delivering the goods in the textile mill of the Sellers Mfg. Co., Saxapahaw, N. C., for the Ste. Genevieve Lime & Quarry Co., Mosher, Mo., for Price Bros. Co., Ann Arbor, Mich., and for the R. F. Huffman Construction Co., Buffalo, N. Y.

Our Satco* lined crankpin bearings are doing their bit toward helping these Diesels deliver steady, trouble-free power. This remarkable alloy embodies all the desirable features of a bearing metal needed to meet today's power production demands: Adequate resistance to crushing stresses; low frictional coefficient; relatively high melting point; and toughness and resistance to deformation.

Satco metal, in the hands of our designers and fabricators, produces a lining that will do the job it is intended to do . . . that will deliver the goods.

*A patented alloy manufactured by National Lead Co. Trade-mark registered.

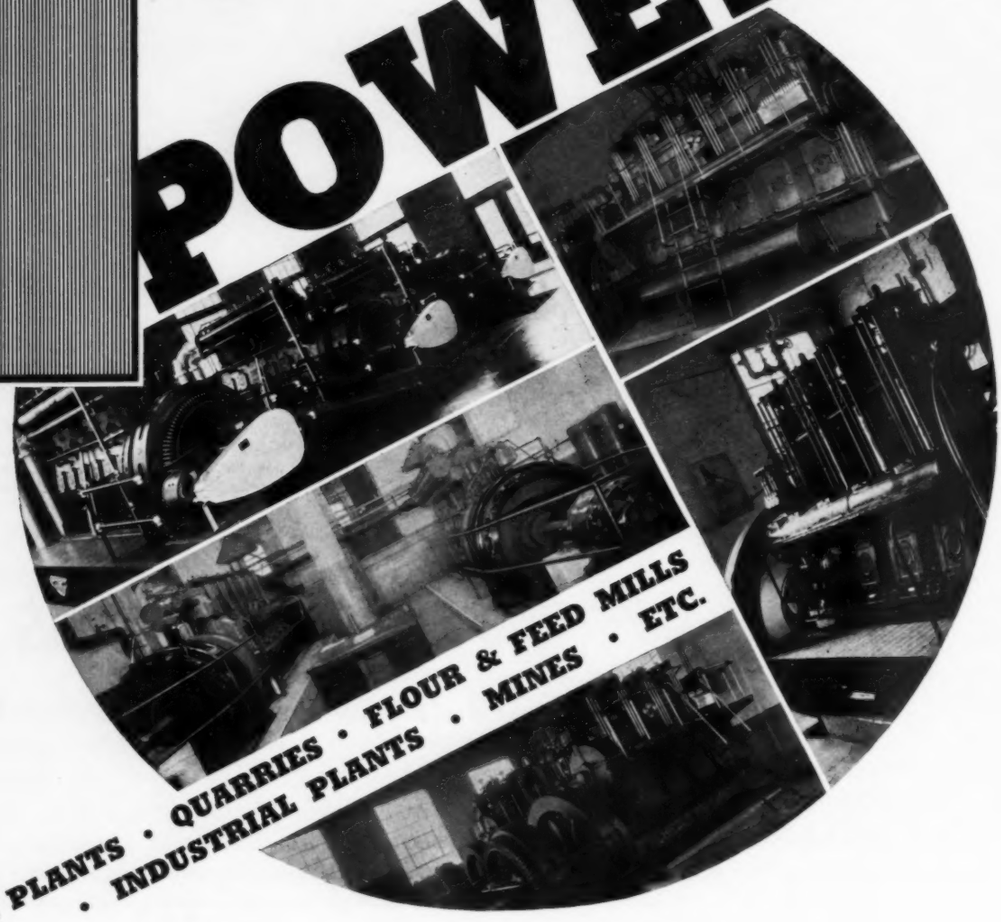
AMERICAN BEARING CORPORATION

Affiliated with National Lead Company

INDIANAPOLIS CENTRIFUGAL American Bearings FORCE **INDIANA**

1¢ ...OR LESS PER K.W.H.

POWER



In plants such as these, and in hundreds of others, CP Diesels are consistently producing dependable power for ONE CENT per K.W.H.—or less!

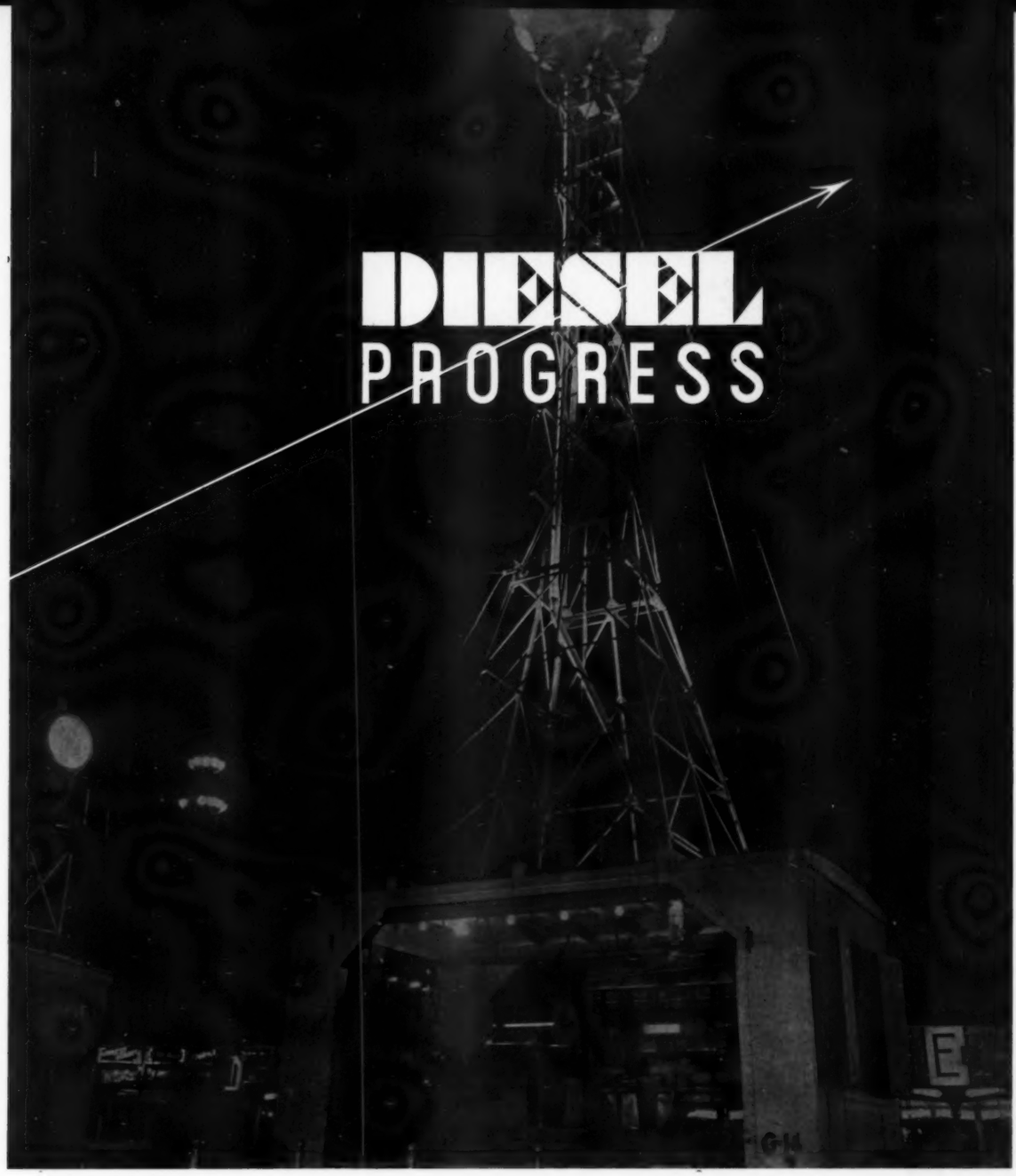
Let our experienced engineers study your power needs and prove the economy of CP Diesels. Your request for a survey involves no obligation.

CHICAGO PNEUMATIC TOOL COMPANY
ENGINE MANUFACTURERS FOR MORE THAN 30 YEARS

6 EAST 44th STREET
NEW YORK • N. Y.

CHICAGO PNEUMATIC DIESELS

M-36-1



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FRONT COVER ILLUSTRATION – Deutsche Lufthansa *Ju 86* airliner, powered with two 600 hp. Junkers *Jumo 205-C* Diesel engines, described on pages 24, 25 and 26.

TABLE OF CONTENTS ILLUSTRATION – Topped by a golden circlet of electricity is this tower, one of seven on Royal American Shows' mammoth Midway. And the source of this light is in the wagon which forms the base of the tower – a Caterpillar Diesel power unit.

"Over There" or Over Here

BETTER PERFORMANCE WITH GREATER ECONOMY

Working on the banks of the Seine River in France, this Thew "Lorain 40" Crane owned by Machinaud Freres, Paris . . . like other Waukesha-Hesselman powered machines in Europe and America . . . is making an impressive record for performance and economy.

The engine—a Model VBKH Waukesha-Hesselman, 4½ x 5¼ bore and stroke, piston displacement 334 cu. in., four cylinders, developing 40-50 hp.—is equipped with overhead valves and removable cylinder head, full pressure oiling, wet sleeve renewable cylinders, American Bosch and Hesselman injection system, and all other features found in the largest Waukesha-Hesselman Engines.

Hesselmans are low compression, solid injection, spark ignition oil engines, burning "modern high-speed Diesel fuels". . . about the same size and weight as gasoline engines and equally simple in construction . . . 20 hp. to 300 hp., both four and six cylinders. *Write* today for Bulletin 1000. *Waukesha Motor Company, Waukesha, Wisconsin.*

WAUKESHA ENGINES

DIESEL PROGRESS

REX W. WADMAN, Editor and Publisher

AT a public hearing before the New York Public Service Commission on July 14th, 1936, the following interesting facts were brought out in reference to the Diesel installation at Number One Park Avenue, New York City.

The New York Edison Company, testifying through its Mr. Jeffe, Assistant to Vice-President in charge of sales, admitted to having paid $149,000 for the Diesel plant at Number One Park Avenue.

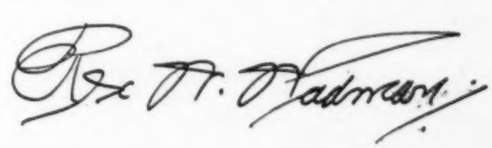
Mr. Jeffe also admitted to having agreed to change all the DC equipment in the building (both building owners' and tenants') to AC without charge. Mr. Jeffe likewise admitted that his company had agreed to change the electrical equipment of all incoming tenants up to the time of the completion of the conversion.

I mention these facts because the actual original purchase price of the Diesel installation in Number One Park Avenue was $122,000 and the plant operated successfully and in accordance with the engine company's guarantee on operating costs for over three years. That, at the time the New York Edison Company bought this plant, it was operating successfully and economically.

A mass of mis-information has been circulated and published in regard to Number One Park Avenue. Damaging statements have appeared in financial newspapers and magazines. So I publish the facts given above to clarify the situation.

Analyzing the situation, it is but another example of the lengths to which a Public Utility will go to put a Diesel plant out of business. Here is a glaring example of where a Public Utility has paid more than the original cost of a Diesel Plant in order to close that plant up and junk the machinery in it, despite the fact that this machinery was in good working order and had a definite re-sale value.

It is of course obvious that the costs of such an expensive operation eventually will fall back on the shoulders of all the customers of the utility in question. An inequitable arrangement which should be outlawed by all Public Service Commissions.



This is not an apartment house. This picture shows the main entrance and part of the building housing the manufacturing departments. In front of the building, bordering the street, is a landscaped park.

DOUBLEDAY, DORAN

By JOHN W. ANDERSON

AT Garden City, Long Island, is the Doubleday Doran publishing plant, well known as the Country Life Press. As the picture of the main entrance indicates, the buildings and surrounding grounds are fully in keeping with the fine residential character of the community itself.

Such an institution presents the usual heating and power problem, and the most economical solution was found years ago through the adoption of a combined steam and Diesel power plant. The first oil engine was installed in 1911 – an 85 hp. single cylinder horizontal machine. But the power plant necessarily grew as the Press expanded in size, and about seven years ago the original units – steam and Diesel – were discarded as too small for further use. At that time an entirely new power plant was built at one end of the property and separate from the main building.

This particular story, however, concerns the Nordberg Diesel which was added to the original power plant in 1923 and which was, and is, located in a room by itself attached to the rear of the main building. The new power plant provided space for this engine, but later it was decided not to move it. While this separates the steam and Diesel power units, it has not proven to be a serious disadvantage.

The Nordberg engine is a type VE, four cylinder, two cycle, port scavenging, crosshead, air injection engine with cylinders 15 by 20 inches, and develops 440 bhp. at 225 rpm.

The steam plant is run to provide all the steam required for heating and other purposes, and the Diesel takes the remainder of the load. Thus the Diesel runs about 10 hours daily from December to March inclusive. The load factor varies, but it averages around 40 per cent. From May to October 15 the Diesel operates 24 hours a day for the five-day working week at a load factor varying from 60 per cent to 90 per cent. During the spring and fall months the unit runs about 14 hours a day at 50 per cent to 70 per cent load. All told, this engine has run about 58,500 hours, and it had its first major overhauling last winter.

At that time the liner wear had become about 0.075 in. maximum, and it was decided to fit new liners and at the same time give the engine a thorough overhauling. Including the parts replaced at that time and all that have been required during the life of the engine, the complete list is as follows:

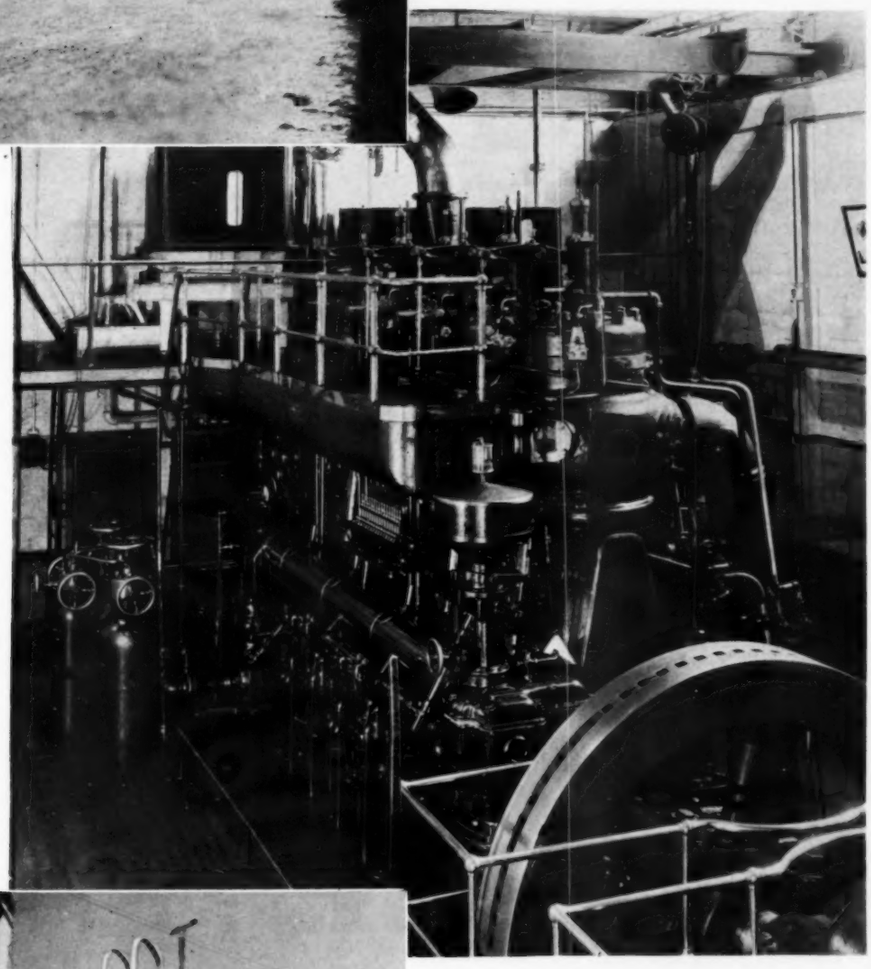
4 cylinder liners.
1 cylinder head (cracked due to sledging up holding down stud nuts too hard – two other heads were cracked, welded, and are still in use).
1 air compressor crankpin bearing (burned out due to oil stoppage).
3 sets of air compressor valves.
2 sets of spray valves.
New piston rings throughout every three years.
Several governor bushings – replaced as worn.
New wooden strips in coil type air cooler on compressor to replace those rotted.

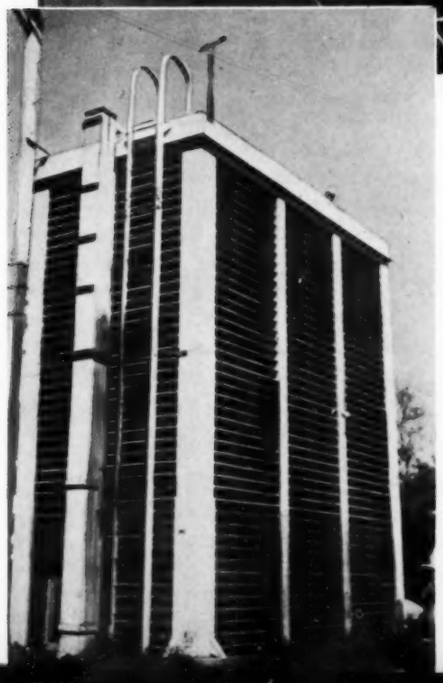
All other parts are the same ones originally supplied with the engine. Any such record as this naturally attracts attention to the operating practices. Such results are not obtained haphazardly.

All air compressor inter and after coolers are blown regularly once an hour. The high humidity usually prevailing, due to proximity to the seacoast, makes this advisable.

Cooling water is obtained from their own wells, about 840 feet deep. It is of good general quality, but there is a high content of iron, which is counteracted by the addition of a commercial chemical compound. The cooling water is recirculated through a cooling tower shown in the picture. The make-up water passes through the oil cooler and thus helps to keep the lubricating oil at a good operating temperature. Pistons are water cooled and are included in the general water cooling system. Once a week, the water is tested for hardness, acidity, and the presence of oil. Just enough potash is added as necessary to give a slightly alkaline reaction.

Lubrication to the bearings is by drip feed. The oil from the bearings drains to a sump





The Nordberg Diesel engine with some of its accessories. Insert — The cooling water tower.

tank, passes through water and filter screens, is pumped to an overhead tank, is cooled, and is returned to the bearings. The bottom of the overhead tank is of conical shape, and into the bottom of this cone the dirty oil settles and passes to a De Laval separator, which runs continuously while the engine is in operation. Once a year all of the oil is drained from the system into a settling tank. It is heated to 180 degrees F., run through the separator, and then is used for make-up.

Lubricating oil feeds to the cylinders from mechanical oilers at four points around the cylinder, just above the exhaust ports. The feed is not timed. Each cylinder gets 8 drops per minute, or 32 drops per minute for the engine. This corresponds to 1½ gallons per 24 hours of operation. The drip from the cylinders drains to a separate tank and is used for lubrication of the elevators. The oil has a viscosity of 52 seconds Saybolt universal at 210 degrees F.

Fuel oil used is number 3 and averages 28 to 31 API gravity. It is delivered to the plant by tank car. Main storage tank is of 10,000 gallons capacity. While this is, of course, a high grade fuel, it has been found the most economical.

Close attention is given at all times to the combustion and to the mechanical condition of the engine. Indicator cards are taken frequently to check the compression and the combustion. The invisible exhaust and the quiet, smooth operation of the engine attest the effectiveness of the attention given.

The low power costs obtained from this plant may be judged from the following figures: A power production of from 10 to 11 kw. hours per gallon of fuel is obtained, depending upon load factor. Fuel costs about 4½ cents per gallon delivered.

One gallon of make-up oil for the bearings is required every 24 hours. Thus the total lubricating oil consumption is 2½ gallons per 24 hours. This corresponds to 4,230 rated horsepower engine hours per gallon.

An engineer is on duty at all times while the engine is running.

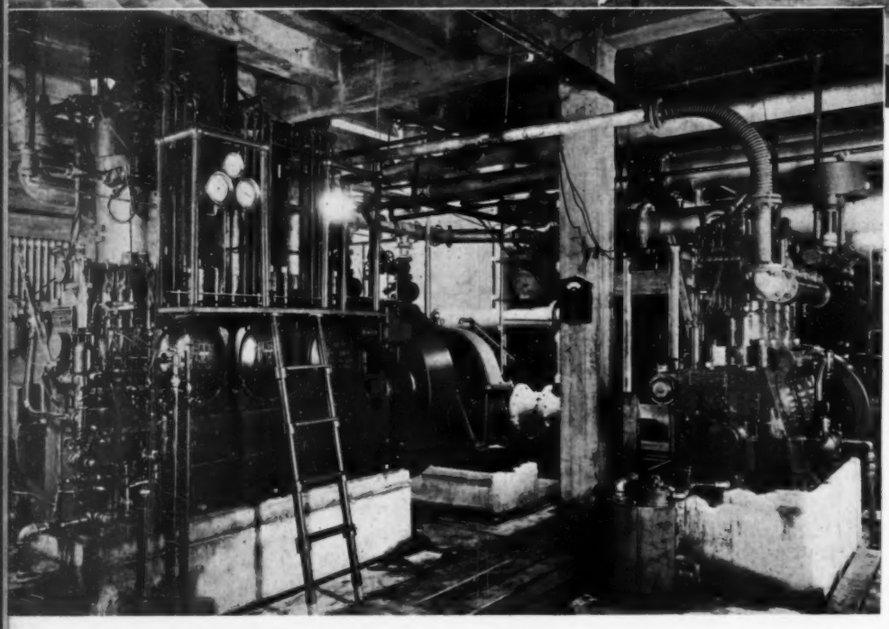
The total cost of all material and outside labor, including the major overhaul last winter, has been less than $1,500 to date.

There is no reason why this engine should not give another 12 to 15 years of service before the next major overhaul, with the same low operating costs during that period, too.

Installed as it was back in 1923, now in its fourteenth year of successful, economical operation, this 440 hp. Nordberg Diesel typifies the long life, persistent, consistent money making ability characteristic of well designed, well installed and well operated Diesel plants.

This installation is an outstanding answer to the question of obsolescence and how unnecessary it is to write off original Diesel plant cost too rapidly.

Great credit must go to the operating crew headed up by Chief Engineer L. Black, who has been in charge of this plant for over 25 years. Incidentally, he obtained his first oil engine operating experience in 1908 on a Hornsby Ackroyd engine. He has shown what careful, consistent attention to operating details can accomplish.



The Astoria Pool where a 200 hp. and a 55 hp. Atlas Diesel circulate 2,400,000 gallons of water every eight hours. Atlas Diesels of 150 hp. each are also installed at the Tompkinsville Park Pool, S. I., and at the McCarren Park Pool in Brooklyn.

DIESEL SWIMMING POOLS

IN July, 1934, the Park Department of the City of New York inaugurated a program of swimming pool development throughout the city to compensate for the lack of adequate natural bathing facilities. The original program called for the construction of twenty-three swimming pool and bathhouse units to range in daily capacity from five to ten thousand people.

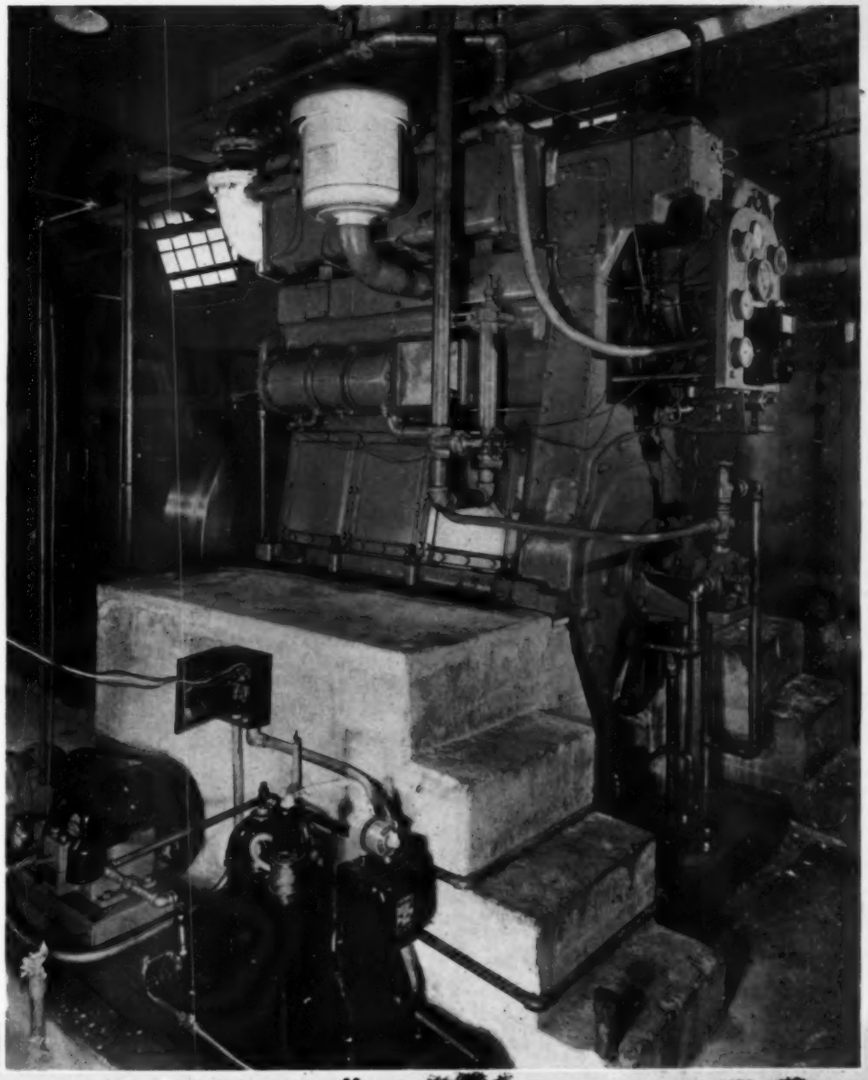
As an immediate program, work was started on eight of the twenty-three units planned for the ultimate system of public swimming pools in the city parks. Subsequently, three additional pools were started; one of them to replace an obsolete pool which had been used for several years without scum gutters, filters, or sterilization of the water. All of these eleven pools will be opened for the general public use by the middle of August, 1936.

In preparing the designs for these new swimming pools, which range in size from 100′ x 165′ to 165′ x 330′ and in total water capacity, including diving and wading pools, from 825,000 to 2,400,000 gallons, the Park Department encountered numerous problems which called for special study and which could not be

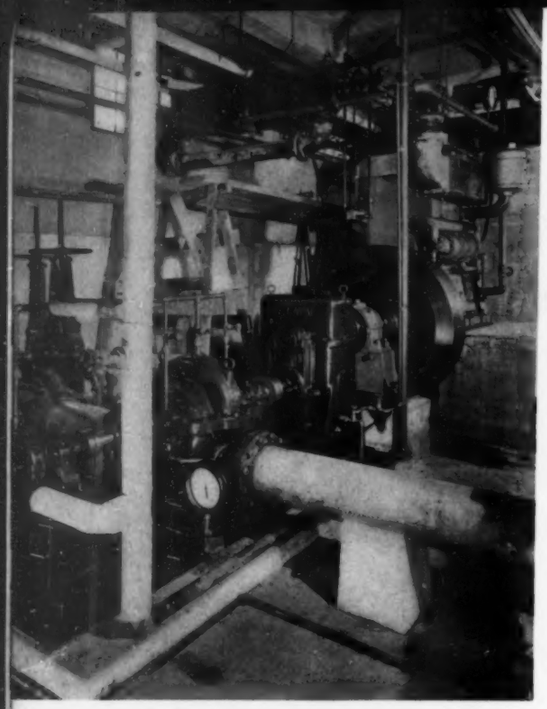
solved by using standard equipment or designs common to other swimming pools in the locality.

In addition to peculiar basic problems of designs, the design was further complicated by the fact that all of these pools were constructed with relief labor and materials under the regulations of the various relief administrations ending up with the Works Progress Administration. Because of the relief requirement that a maximum of labor and a minimum of fabricated material be used, the filters in all except two of the eleven pools are of the open gravity type, consisting of reinforced concrete tanks. All of these pools are designed to use the most complete and effective system of water treatment which has been developed.

Where possible, water is circulated from the pools to the filters by gravity, without pumping. Local conditions permitted the use of this method in six of the installations; in the other five jobs it was necessary to install dual pumping systems, one pump to raise the water from the pool sump to the water level in the



The Thomas Jefferson Pool, 1st Avenue and 113th Street, Manhattan. A Cooper-Bessemer 120 hp. Diesel engine handles the circulation of 1,080,000 gallons of water from filters to the pool. Auxiliary equipment includes an Air Maze air filter, an Alnor Pyrometer and a DeLaval lubricating oil centrifuge.



Another view of the Cooper-Bessemer Diesel at the Thomas Jefferson Pool. In the foreground are the DeLaval gear box and pumps and, supported from the ceiling, the Foster-Wheeler exhaust-gas heater. While not shown in the photographs, all four Diesel pool installations are provided with Maxim silencers.

filtering system, and the other pump to force the water from the filters to the pool injectors.

In determining the power equipment to be used in pumping there were obviously two practical systems; one using electric power and the other using Diesel power. The use of Diesel power in a municipal improvement in New York City is an innovation and somewhat in the nature of an experiment. Partly because of the novelty and partly as a means of securing comparative data, it was decided to power only four of the jobs with Diesel engines and the other seven with electric motors.

A preliminary analysis of the comparative cost between the use of electric and Diesel power, based on a 150 hp. installation, showed a saving during an operating season of $1,860.20 and was arrived at as follows:

Summary of Operating Costs – Electric Drive Pumping:

Two 75 hp. motors requiring 61.5 kw. input	$2,443.00
Three months' demand charge	660.40
Two months' partial demand charge	147.60
Total electric energy cost	$3,251.00

Summary of Operating Costs – Diesel Engine Drive Pumping:

Total fuel and lubrication cost of one 150 hp. Diesel per 24 hrs.	$ 10.80
Fuel and lubricating cost per 100 days	1,080.00
Additional labor and maintenance for 100 days of operating	300.00
Total operating cost	$1,390.80

The four Diesel engine jobs are:

1. Thomas Jefferson Park, 1st Avenue and 113th Street, Manhattan, where the pools have a water capacity of 1,080,000 gallons and where the water runs from the pools to the filters by gravity, so that the job uses one Diesel engine, 120 hp., 3-cylinder.

2. Tompkinsville Park, Staten Island, where the pools have a water capacity of 988,000 gallons and where the water has to be pumped from the pools to the filters but, in this case, a single engine, 150 hp. 3-cylinder, is used with two pumps connected in tandem.

3. Astoria Park, Queens, where the pools have a water capacity of 2,400,000 gallons, and where two Diesel engines are used; one, 200 hp., 3-cylinder, for the circulation of water to the pools; and one, 50 hp., 3-cylinder, to raise the water from the pools to the filters.

4. McCarren Park, in the Greenpoint section of Brooklyn, where the water capacity is 1,865,000 gallons, and where a single engine, 150 hp., 3-cylinder, is used to run a single pump.

These four locations were selected for the trial of Diesel plants because each one is different in size and method of handling water, and together they cover almost every problem apt to be encountered in any of the new pools.

The specifications for the Diesel engines were patterned after those used by the United States Navy and were so worded that only reputable manufacturers of the best Diesel equipment would be able to qualify for their manufacture. The centrifugal pumps were supplied by the engine manufacturers and were specified only by characteristics and efficiency and further by limiting their manufacture to the three best pump manufacturers in the country. It is worthy of note that the pumps supplied are the most modern of their type yet developed, and whereas the specifications required only 85 per cent efficiency, actual tests prove their efficiency at 89½ per cent.

Each of the plants was designed for reliability, simplicity, and economy and ease of operation. The specifications called for low speed, heavy duty, 4-cycle solid injection units, driving single stage centrifugal pumps through speed-increasing gears of the double helical herringbone type. Piston speed was specified at 850 feet per minute with a maximum Mean Effective Pressure of 78 pounds.

All the engines are equipped with exhaust silencers, oil centrifuges and a complete installation of pyrometers for controlling them under all operating conditions and to protect them against damage by the loss of water or oil pressure. Lubrication is one of the forced feed type.

Each plant is designed to use the exhaust heat for the production of hot water through a waste heat boiler. The hot water is used during the day in the showers in the bathhouses; during the night, when necessary, the pool water is circulated through the waste heat boiler to raise the temperature of the water in the pools. The engine cooling system is provided with three different methods of cooling, by taking water from any one of three different sources.

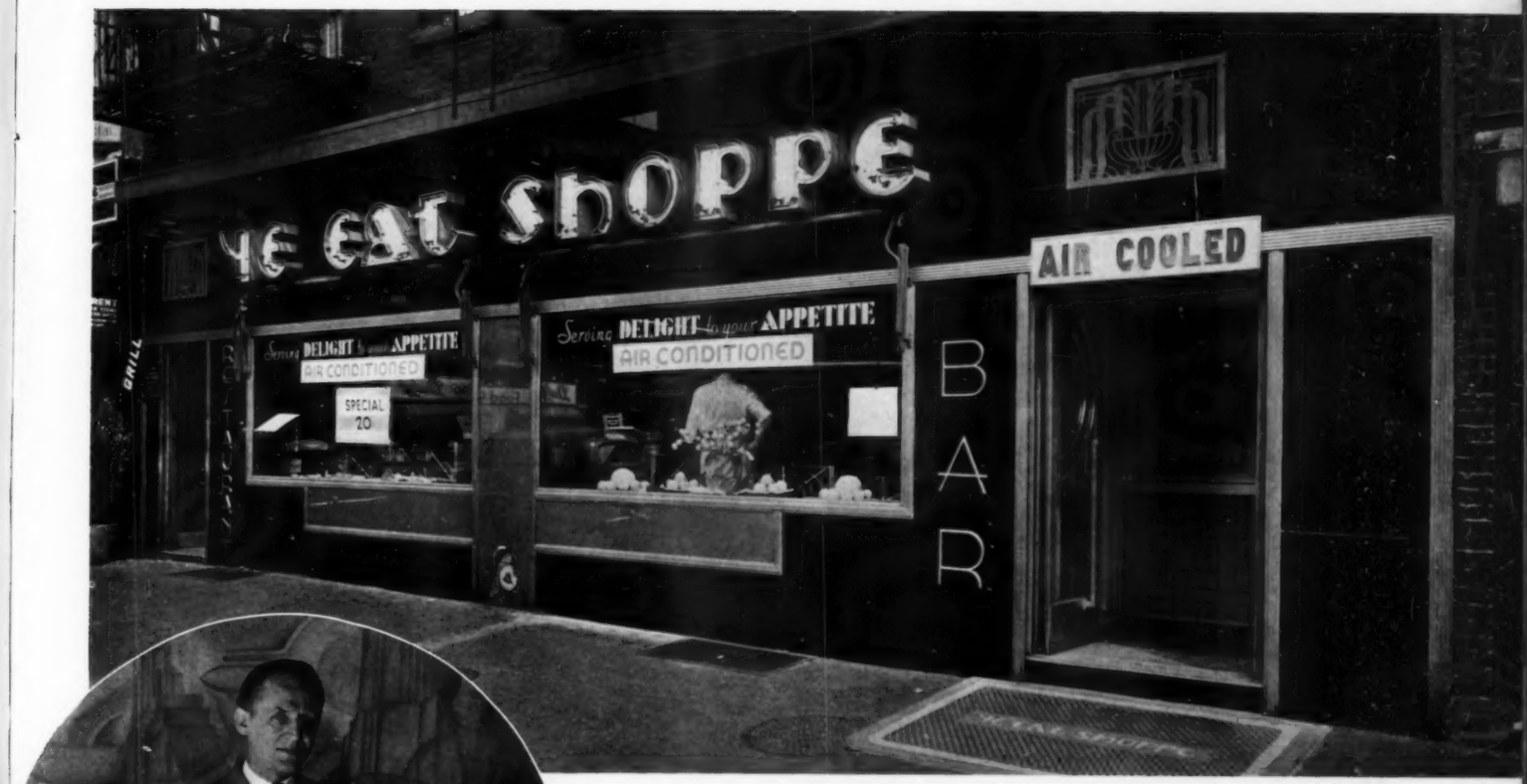
All engine foundations are designed to reduce to a minimum the transmission of vibration. The concrete foundations are isolated from building structures by natural cork mats in waterproof pits.

These new power plants are being operated by competitive City Civil Service personnel. This personnel has been trained by representatives of the engine manufacturers and they are supplementing this training by courses in design and operation of Diesel engines.

These four Diesel engine pumping plants were designed by engineers with long experience in this type of work. They are the most up-to-date installations of their kind in the country. All relief authorities acknowledge that they are the best designed and constructed parts of the most outstanding developments accomplished with relief funds by the New York City Park Department which has completed the most worthwhile improvements in the country with the use of work relief labor and materials.

An interesting sidelight on the Diesel Industrial School situation is brought out in connection with this article. Henry Hassenforder, who operates the Diesel plant at the Astoria Pool and Egan Russell who operates the Diesel plant at the Thomas Jefferson Pool, are both graduates of the Hemphill Diesel Schools, having graduated from the Hemphill Long Island City School. Proving very definitely that these Diesel Industrial Schools are serving a useful purpose and that the rapid increase in number of Diesel applications is creating positions for graduates from these schools.

Officials of the New York City Park Department co-operated splendidly with our editorial department in the preparation of this article and our sincere thanks are extended to them for the assistance they rendered in supplying facts and figures and enabling us to take such excellent photographs – Editor.



The smart, modern facade of the recently Dieselized restaurant on Eighth Avenue north of 45th Street, New York City. Inset: The owner, Mr. Clyde Miller, former Broadway stage star.

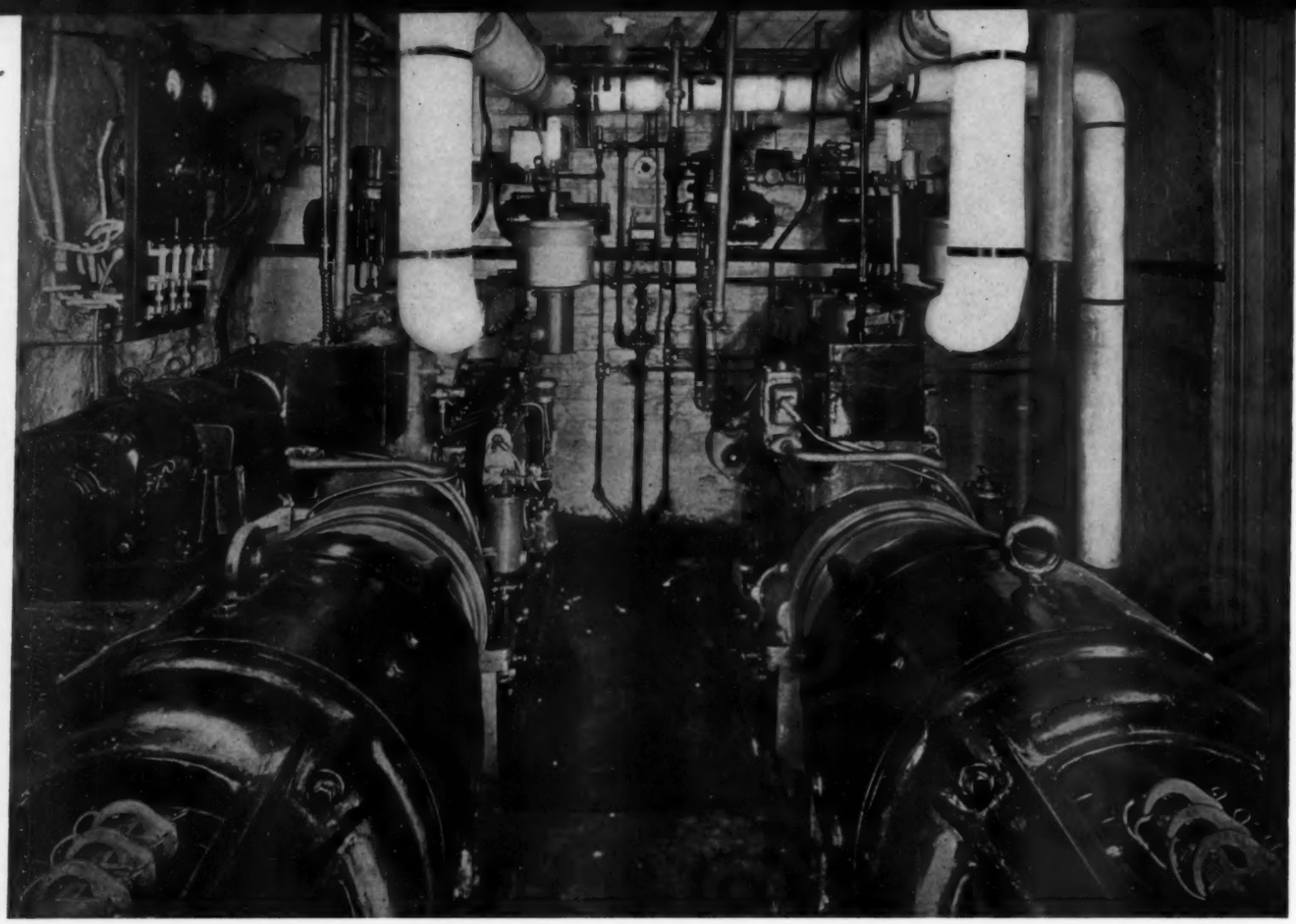
YE EAT SHOPPE

A Fully Automatic Diesel Plant

FOR fifteen years Mr. Clyde Miller has purchased electric power for his restaurants at 732 and 734 Eighth Avenue, New York City, and like countless others has felt that this charge constituted too great a part of his overhead. Determined to rectify this situation, Mr. Miller recently installed a completely automatic Diesel electric plant and is now in the enviable position of being able to generate his own electricity for one and two-tenths cents per kilowatt hour and to get his hot water as an extra dividend. Applying the difference between previous and present power costs, he will pay for the plant in less than five years.

The older and smaller of the two restaurants was started in 1920, at the time of the Actor's Equity strike, and proved so popular with stage folk that Mr. Miller never returned to the theatre. The newer and larger establishment next door is much more elaborately furnished to accommodate leisurely dining and is also extremely popular with the theatrical profession and theatre audiences before and after Broadway shows. The latter is comfortably cool as a result of thorough air conditioning, and both are open to the public twenty-four hours a day. Quite obviously, Mr. Miller has a considerable lighting load in addition to his power requirements. He was formerly operating under Edison rate Number Three and paid slightly under $7,000 yearly for approximately 150,000 kwh. He is guaranteed a maximum annual Diesel cost of $1,800, thus effecting a saving of 3.46 cents per kwh., or about $5,200 each year. Over and above the oft mentioned Diesel operating economy, there is an additional saving of $360 in this particular case by securing hot water service from the Diesel cylinder jacket water.

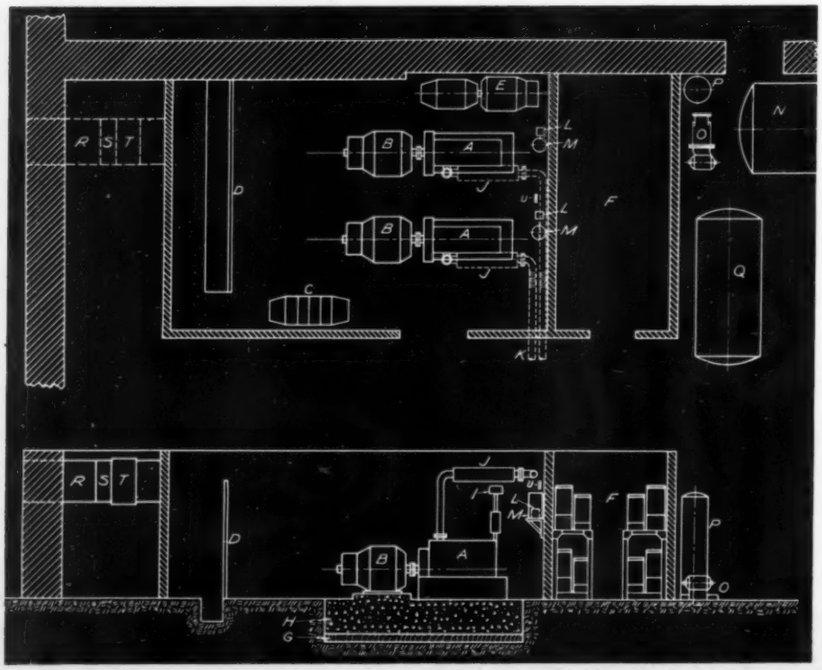
The plant was installed by Automatic Diesel Electric, Inc., in conjunction with Petroleum



View from switchboard of the fully automatic Diesel-electric and auxiliary equipment.

Heat and Power Company, Inc., both of New York City. The two main units are six cylinder Buda Diesels directly connected to 35 kw. direct current Ideal generators. In addition, there are two Ideal motor-generator sets, one of ten kw. capacity for miscellaneous AC equipment and one five kw. booster set. Other equipment includes 115 cells of Philco 200 ampere-hour batteries, Burgess exhaust silencers, Korfund Balanced Isolator for engine bases, Nugent oil filters and Air Maze air filters. Fuel oil is transferred from the 1,080 gallon main tank to the engines by two Viking pumps and a Midget Levelometer in the engine room accurately indicates the fuel level in the tank.

In operation, this fully automatic Diesel plant differs from the ordinary manual controlled installation just as the name implies. One engine supplies the power requirements with the other as a standby. In other words, whenever the load demands, the second engine is automatically thrown onto the line or, conversely, taken off. The motor-generator booster set acts as a voltage regulator on the line with the batteries. As an excessive load requires more current and tends to depress the line potential, the Motor Generator set acts with the batteries to maintain it. However, as the load



Legend

A Six cylinder Buda Diesel engine
B 35 kw Ideal generator
C Ideal balancer set (booster under)
D Switchboard
E Ideal motor generator set
F Battery room—Philco Batteries
G Cork mat under foundation
H Foundation block
I Air intake muffler and filter
J Exhaust muffler
K 3 in. exhaust lines to chimney
L Fuel transfer pump
M Auxiliary fuel or day tank
N 1000 gallon fuel storage tank
O Hot water pump
P Hot water sump tank
Q Hot water storage tank
R Ventilating duct from sidewalk grating
S Air filter
T Ventilating blower
U Levelometer

drops below a certain level, the action reverses and charges the batteries. In this way, the line potential is held constant and the batteries are kept at a fixed point of charge, thereby reducing plate wear to a minimum. Briefly, the automatic Diesel installation, developed and perfected by Mr. C. F. Strong, consists of the application of temperature, pressure and relay controls operating solenoids properly placed to govern the operation of the generating units. This eliminates the constant presence of an operator or engineer and yet guarantees the most efficient operation of the Diesel and electrical machinery. The automatic control is further applied to maintain all essential service from the battery at about half the normal illumination in case the main fuses blow, or if for any other reason, the line goes dead. In this event, the above emergency load is immediately shifted to the batteries alone which, since they are always fully charged, can function satisfactorily for some hours if occasion requires.

An alarm device gives instant warning of trouble of any kind by actuating a buzzer at the cashier's desk. In case of engine trouble, the unit is automatically stopped and the other started. Automatic Diesel Electric, Inc., maintains day and night service for repairs, when needed, as well as periodic inspection so that the owner has a maintenance guarantee equal to, if not better, than when he was using purchased power. It is estimated by the company that the high speed Diesels of today require less than $1.00 per hp. per year for repair parts based upon surveys of such Diesels in active service. This need not concern the owner, however, since it is included in his operating guarantee along with fuel and lubricating oil, inspection, labor, etc.

Naturally, the chief advantage of the automatic system is the elimination of operator expense without sacrificing dependability and maximum efficiency for all load conditions.

Previous to 1920, when Clyde Miller bid farewell to the stage, he delighted thousands with his eccentric dancing. This type of entertainment met with immediate public approval, due largely to his natural gift for developing new and original routines. Among some of the many shows featuring Mr. Miller were George M. Cohan's "Royal Vagabond," "The Velvet Lady," and "Fancy Free." In the latter, he appeared with Marilyn Miller and was successful in adapting his style of dancing to her ballet. He is by nature alert and progressive and was quick to sense the necessity of air conditioning in the modern successful restaurant. He was equally alert to the economy of Diesel engines when the cooling equipment boosted his electric bills, and now owns one of the most compact and fool-proof Diesel installations in the city.

It was extremely interesting and enlightening to have the opportunity of sitting down with Mr. Miller and discussing with him his new Diesel installation, his reactions from a non-technical man's point of view to this type of equipment and, perhaps most interesting of all, the many less significant yet still important effects that the conversion to Diesel generated electric current has upon restaurant operation.

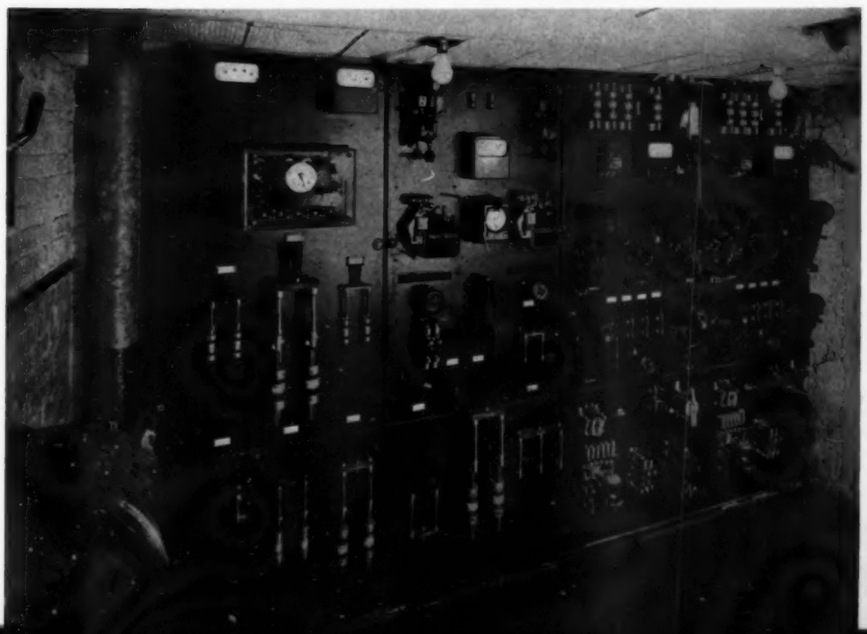
Coming from a brilliant career on the New York stage, Mr. Miller naturally knew little and cared less about the methods and cost of generating electricity. It became quite a different story, however, when he personally met the electric charges for his restaurant which were major items of monthly expense. Even

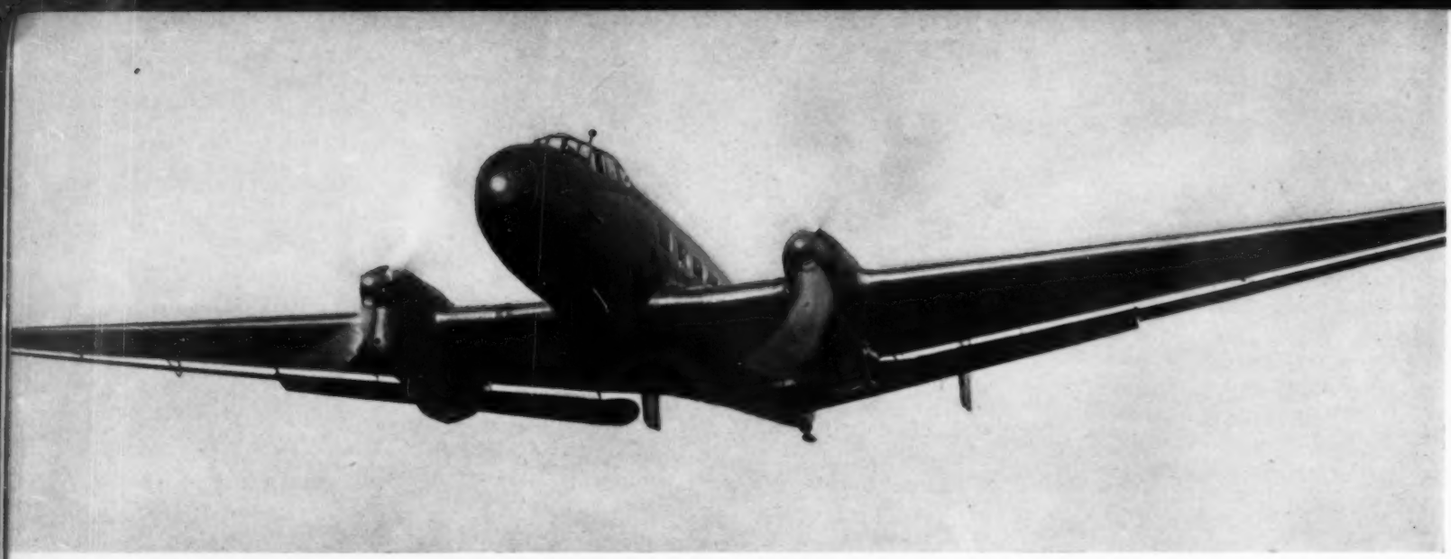
Tier upon tier of Philco batteries which constitute a vital part of successful automatic Diesel operation.

then such bills were taken more or less as a matter of course since "everyone" was paying at the same rates. However, with the advent of air conditioning the item of electric power suddenly sky-rocketed to eight or nine hundred dollars a month and Mr. Miller rebelled. He acquainted himself with Diesels, studied their characteristics and cost of operation. He then took the next logical step and purchased Diesels. The main benefits have been thoroughly discussed but to the owner there are numerous minor points of saving which added together become very worthwhile. A typical example is the gas toaster which chefs were constantly keeping lighted though no bread was being toasted. With inexpensive Diesel generated electricity this unit will be supplanted by a "Toast-Master" which costs next to nothing to operate and only heats when in use. Like many others, Mr. Miller has discovered that the advantages of Diesel engines are legion.

An interesting advantage of the completely automatic Diesel-electric plant claimed by its designers is that by permitting reasonable loading of the engines, the automatic plant can be of much less capacity than needed in a manually controlled plant. It is also claimed that the cost of the completely automatic plant including necessary batteries and control devices will compare very favorably with that of the manually controlled installation required for the same building load. Obviously, if batteries be added to the manual-control plant and the cost of these added to the total, the cost of the automatic plant will be less by that amount.

The "brain" of the automatic Diesel plant which eliminates the necessity of constant personal supervision.





Deutsche Lufthansa Diesel-engined airliner, Junkers "Ju 86," in flight

DEUTSCHE LUFTHANSA AIRLINE

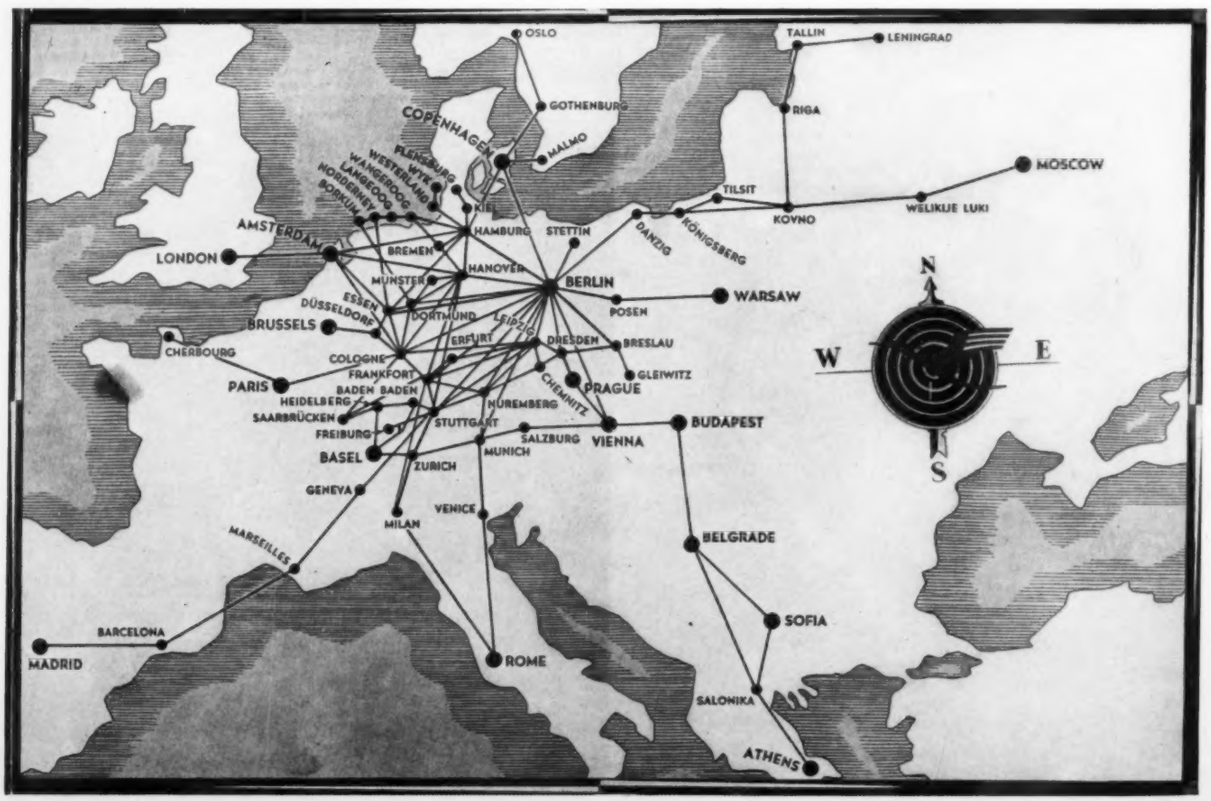
By PAUL H. WILKINSON

DEUTSCHE Lufthansa – the famous German national airline whose routes cover most of Europe and reach across the South Atlantic to South America – undoubtedly is the most progressive airline in the world today. This statement is not made to belittle the efforts of other airlines, but rather to emphasize the importance of the pioneering work of D.L.H. with the Diesel-engined airplane. Soon D.L.H. will be an active contender for passengers and mail across the North Atlantic, and the American public will be able to see for themselves what may justly be considered the next important step in the advancement of aviation.

Part I of this article deals with the Diesel-engined landplanes used on the D.L.H. airlines in Europe. The map shows the present extent of its Continental system – reaching north to Leningrad and Oslo, south to Athens and Rome, east to Moscow and west to London and Madrid. The extensive airlines in Germany itself were used as the proving ground for the development of Diesel-engined aircraft – a development sadly neglected in the United States where we pride ourselves on the so-called safety of our planes which, nevertheless, use highly explosive fuel.

The Diesel-engined landplanes operated by D.L.H. are all of Junkers manufacture and are equipped with engines made by the same concern. The types used comprise the four-engined *G 38* and the three-engined *Ju 52/3m*, which have already been described in DIESEL PROGRESS, and the *Ju 86*, which is illustrated and described in this issue.

The *Ju 86* transport plane was developed from

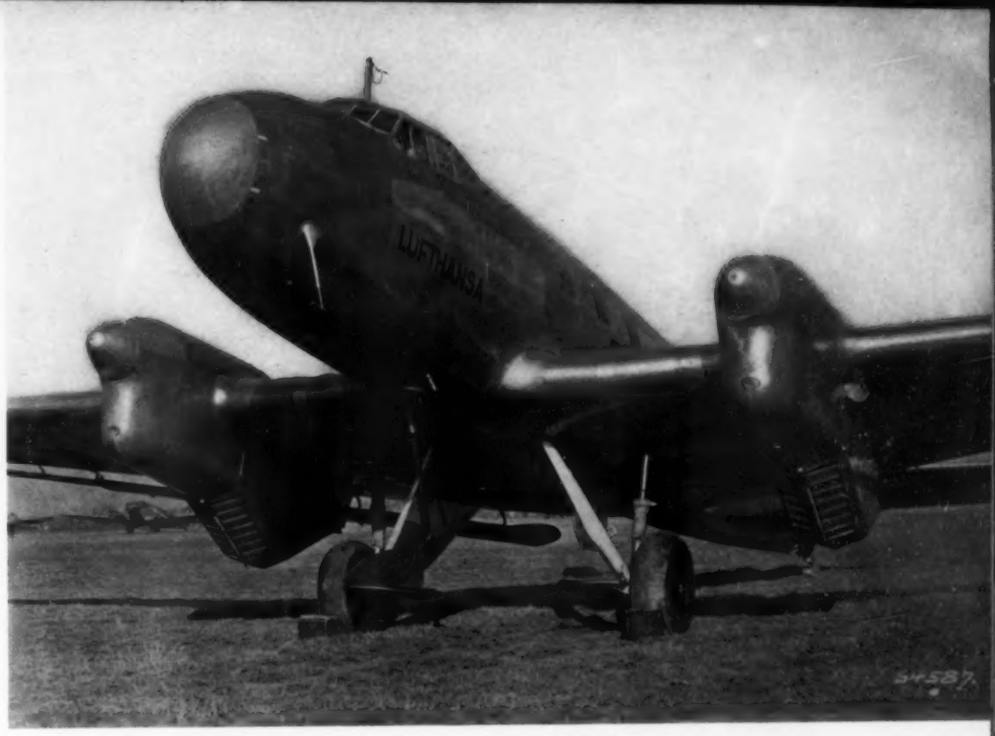


the *S 36*, a twin-engined mail and aerial survey plane built in 1927. As will be seen from the illustrations, it conforms to present-day conceptions of high speed air craft, being a twin-engined, all-metal, low wing cantilever monoplane with retractable landing gear. The fuselage is substantially of oval section, with four longtitudinal spars connected together by vertically disposed ribs, and a smooth outer skin of sheet duralumin attached by countersunk rivets. One view of the interior of the cabin shows how it appears when the plane is to be used for freight carrying, or prior to the installation of the necessary equipment for passenger operation.

The two outer sections of the wings are rigidly attached to the center section by ball-and-socket joints. They are of Junkers double-wing design, with an auxiliary wing attached to the trailing edge of the main wing which makes for improved take-off and landing speeds. The same double-wing construction is used in the tail group for the elevator, which is balanced and is provided with a trimmer for varying conditions of load. The stabilizer is also adjustable from the pilot's cabin. The rudders are equipped with flaps so that a normal flight path can be maintained with only one engine.

Power is provided by a Junkers *Jumo 205-C* Diesel engine mounted in the leading edge of each wing. The engine is rated at 600 hp. at 2,200 rpm. at 8,000 ft. Underneath the engine nacelle is the radiator with its adjustable shutters. Three-bladed controllable-pitch propellers, manufactured by Junkers under Hamilton Standard license, are used. The excellent streamlining of the engines will be noticed, the frontal area being about one-half that of radial engines of similar power.

The fuel tanks are mounted in the wings between the wing beams, adjacent to the engines, and can be removed after detaching the cover plates underneath. The normal load carried is 170 gallons of Diesel fuel, which is drawn from the tanks by two *Jumo* fuel pumps mounted on each engine. A 13-gallon oil tank is installed in the leading edge section of the wing, adjacent to each engine. Cooling is effected by a Junkers tubular oil cooler controlled from the pilot's cabin.



Junkers "Ju 86" airliner ready for take-off

The entrance to the plane is through a large door on the port side, behind the wing, which opens into an ante-room leading to the main cabin. Ten adjustable seats, upholstered in leather, are provided for the passengers. As will be seen from the illustration, the seats are staggered to allow ample leg room. The walls of the cabin are efficiently sound-proofed, and the lights are concealed behind an overhead lighting strip. The ventilating system is provided with both general and individual regulation for the comfort of the passengers. Hot air is used for heating the cabin when necessary. Aft of the cabin and adjoining the ante-room are the toilet and the main baggage compartment.

The pilot's cabin is entered from the main cabin and has an emergency exit through the roof. A good view of the arrangement of the controls and radio equipment is shown herewith. The pilot's seat is on a higher level than that of the radio operator, who occupies an auxiliary seat which permits him to get back into the cabin easily to attend to the wants of the passengers. Dual control is not provided, as this type of plane is not used for very long distances.

The main cabin has a cubic capacity of 360 cu. ft. when equipped for passenger carrying. When the passenger equipment is removed, however, and the plane is used exclusively for freight, the available space is increased to 406

Deutsche Lufthansa airliner "Dresden"

View of fuselage construction of Junkers "Ju 86"

Passengers' accommodations in Junkers "Ju 86"

Pilot's cabin, controls and radio

cu. ft. In addition, there is a baggage compartment in the nose which provides 42 cu. ft. of space, and another one behind the main cabin of 81 cu. ft. capacity.

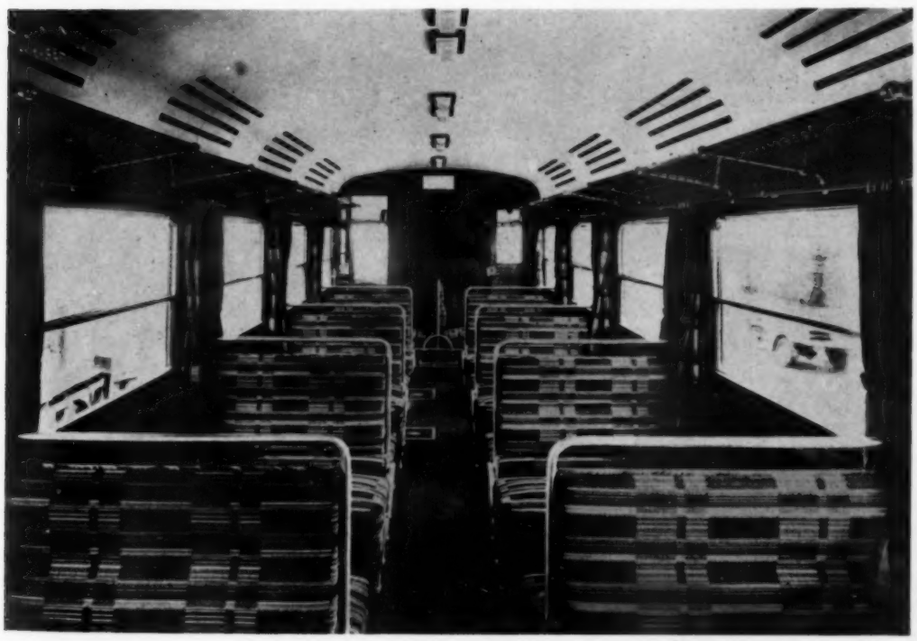
The span of the latest model *Ju 86* is 74 ft., its length is 57 ft. 6 ins., and its hight is 15 ft. 9 ins. Its weight when empty it 10,550 lbs., the useful load (including passenger equipment) is 5,900 lbs., and its gross weight is 16,450 lbs. As the wing area is 882 sq ft., this makes the wing loading 18.6 lbs. per sq. ft. The power loading, based on the total of 1,200 hp. developed by the two engines, is 13.7 lbs. per hp. The maximum speed of the new *Ju 86* is 226 mph. at 8,000 ft., it cruises at 210 mph. at 12,000 ft., and it lands at 60 mph.

Part II, describing more of the equipment of the Deutsche Lufthansa airline, will appear in the September issue of DIESEL PROGRESS.

STREAMLINERS IN ITALY

By ANTONIO GIORDANO

THE Piaggio & Co., Società Anonima, Genoa, is building in its Genoa-Sestri plant ten stainless steel Diesel electric and ten Diesel special rack and adhesion railcars for the Società Italiana Strade Ferrate del Mediterraneo, and for the Ferrovie Calabro-Lucane. It should be noted that the Piaggio & Co. has acquired the license for the construction of stainless steel vehicles from the Edw. G. Budd Mfg. Co. of Philadelphia with steel containing 18 per cent of chromium and 8 per cent of nickel. The Piaggio & Co. has had built in Italy, according to the Budd patents, special electric welding machines which are the only ones existing capable to undertake the welding of stainless steel in the short fraction of time between 1/50th and 1/500th of a second.



The ten Diesel electric railcars have the following dimensions:

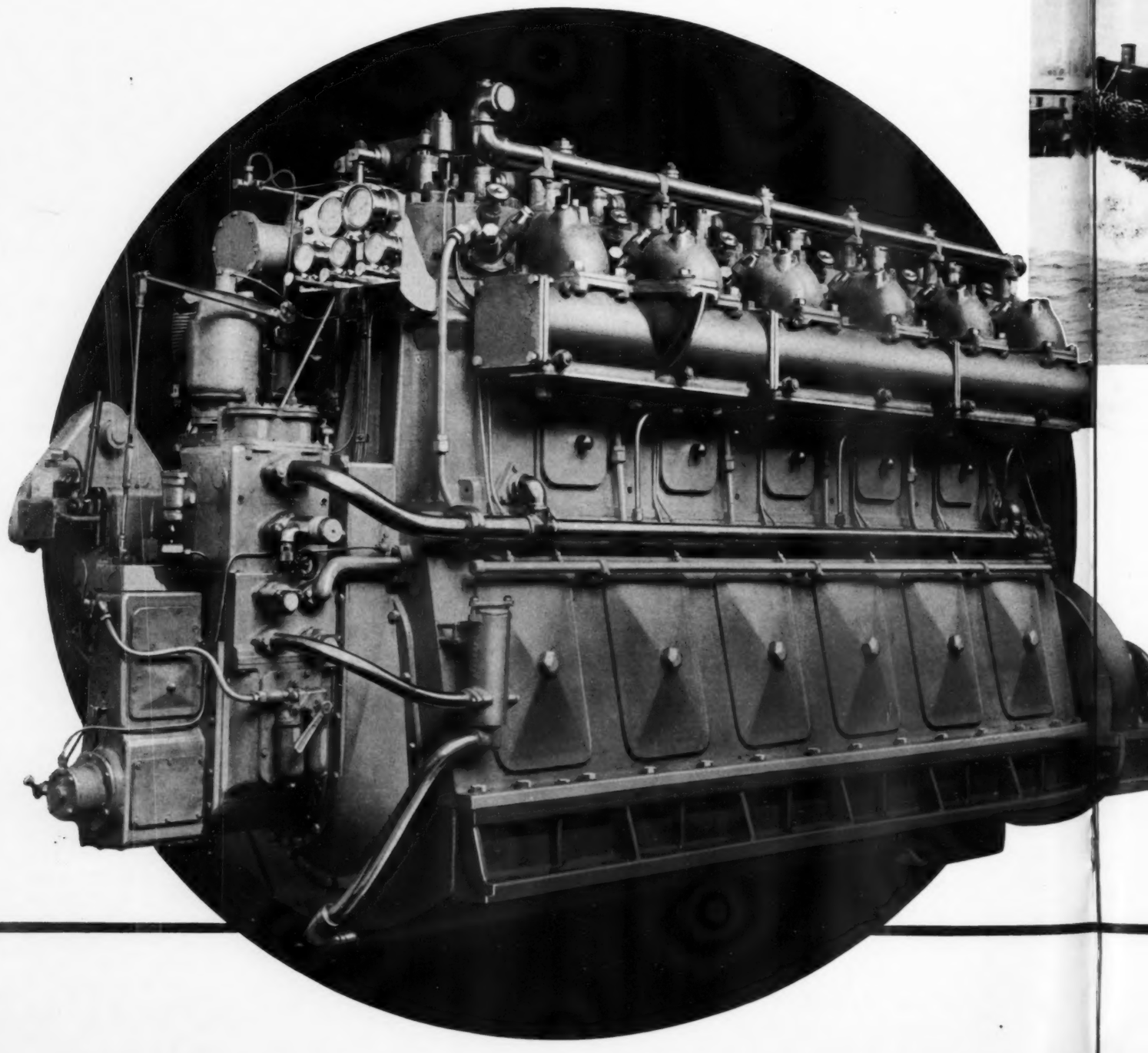
Total length of the body	15,600 mm.
Distance between the pivots of the bogies	10,080 mm.
Breadth	2,450 mm.
Height from the rails level	3,300 mm.
Gauge	1.435 & .950 mm.
Power of the engines (two engines)	130 hp. each
Number of revolutions per minute	1,500
Maximum speed	100-120 km.-hour
Weight of the structure and covering of the frame in stainless steel	2,600 kg.
Weight of the railcar ready for for operation	17,5 tons
Weight of the body fully fitted	5,0 tons
Weight of the bogies	5,2 tons
Weight of the motors, electric generators, etc.	7,3 tons
Total capacity of passengers and baggage	8,0 tons
Seats (first and third class)	54

The two ends have a streamlined design just as the trains now in operation in the United States of America. The body is divided as follows: forward driver's cabin, first class compartment, baggage room with annexed toilet, etc., third class compartments and aft driver's cabin. These cars can be considered as a novel type not only in respect to the employment of light and highly resistant metals in the body, but also in respect to the machinery as the Diesel engine drives an electric generator which supplies the electricity to the electric motor, mounted on the bogies, which motor, by means of appropriate gears, transmits the movement to the wheel. Each bogie carries a

. . . . *And now please turn to page* 47

Symbol of Economy and Dependability

The towboat *Edco* is powered with the six-cylinder Winton-Diesel engine shown below. This dependable unit, developing 250 h.p. at 375 r.p.m., provides the economy vital to profitable operation



WINTON-DIESEL POWER DEMONSTRATES ITS *Economy* AND *Dependability* IN THE TOWBOAT *Edco*

Those familiar with workboat operations in waters off Wilmington, N. C. are cognizant of the outstanding service that the towboat *Edco* has been giving during the past several months. This boat is owned by the Ethyl-Dow Chemical Co. of Wilmington. It was designed by Standard Shipping Company and built by Jakobson and Peterson, Inc., Brooklyn, N.Y. Principal dimensions are as follows: Overall length 64 feet, 6 inches; beam moulded 15 feet; draft moulded 7 feet, 5 inches. It is used for general towing in the Wilmington and Cape Fear area and its full-welded, steel construction makes it a seaworthy unit capable of outstanding service. The boat has a speed of 12.5 miles per hour. The power plant in the *Edco* consists of one Model 133-6, six-cylinder Winton-Diesel engine developing 250 h.p. at 375 r.p.m. and a 5 k.w., 32-volt Winton-Diesel generator set. These power facilities have made possible a highly satisfactory performance record.

WINTON ENGINE CORPORATION

CLEVELAND · · · · OHIO · · · · U. S. A.

New streamlined De Dietrich railcar. Two 150 bhp. Lorraine engines. Sixty passengers carried at 83 mph.

LONDON LETTER NO. 9

By GEORGE LIND

In January of this year there were 1,840 Diesel-powered trains and railcars built or under construction throughout the world. Of this number 803 were accounted for by France and Germany. Since January, the total has risen at an amazing rate, and, although no exact figures are at present available, well over 2,000 railcars and Diesel trains are in use in Europe alone.

Of the countries to show increasing enthusiasm for the new form of transport Denmark and Italy are the outstanding examples. In France and Germany, additions to the present rolling stock are being made progressively, the majority of the principal French railways and the German State railway having planned their program already at the beginning of the year.

The state of affairs in this country is still thoroughly depressing. At the moment, our four great railway companies, the Great Western, the London Midland & Scottish, the London and North Eastern and the Southern, own between them 25 small single coach railcars, the largest of only 260 bhp. That this retrograde policy is not merely the result of super-cautiousness is well known, and the sooner the railway companies' shareholders take a hand in altering it the better it will be for us all. Other countries with equally large coal fields as our own are proving that the advantages of Diesel-powered trains can be enjoyed without materially affecting the coal interests. So that the British coal owners' present cantankerous attitude is not in the least justified.

To come now to a more detailed description of recent European developments, here are some particulars of two new French railcars, one built by the De Dietrich Company and the other by Automobiles Berliet.

The De Dietrich is a semi-streamlined machine and can carry 60 passengers and luggage at speeds of up to 83 mph. During its trials it has covered the 219 miles between Nancy and Paris in 203 minutes, including a four-minute stop at Chalons – a particularly good performance for a car of this type.

The two engines used are 4-stroke pre-combustion chamber Lorraine units developing 150 bhp. at 1,700 rpm. and weighing only 11.7 lbs. per bhp. net. The very low weight to power ratio has been achieved by the use of an aluminum alloy engine block and crankcase, and by the hollow boring of the crankpins and crankshaft. The drive is taken from the engines through 5-speed Wilson epicyclic gearboxes and Vulcan-Sinclair fluid couplings to two pairs of bogie wheels.

Air conditioning has been adopted for the seating and luggage space, all windows being permanently closed. In winter the temperature is maintained at a steady 20 deg. C., and in the summer at 3 to 4 deg. below that of the outside air.

The Berliet railcar is built in two types, one for use only for parcels and light goods traffic and the other for passengers and luggage. For the first time in France two engines are mounted side by side, in the manner pioneered by Frichs in Denmark for their express railcars. Each power unit is rated at 125 bhp. at 1,500 rpm., and is direct-coupled to a D.C. generator, which, in turn, supplies current to 70 kw. traction motors. The maximum speed of the complete cars fully loaded is 75 mph.

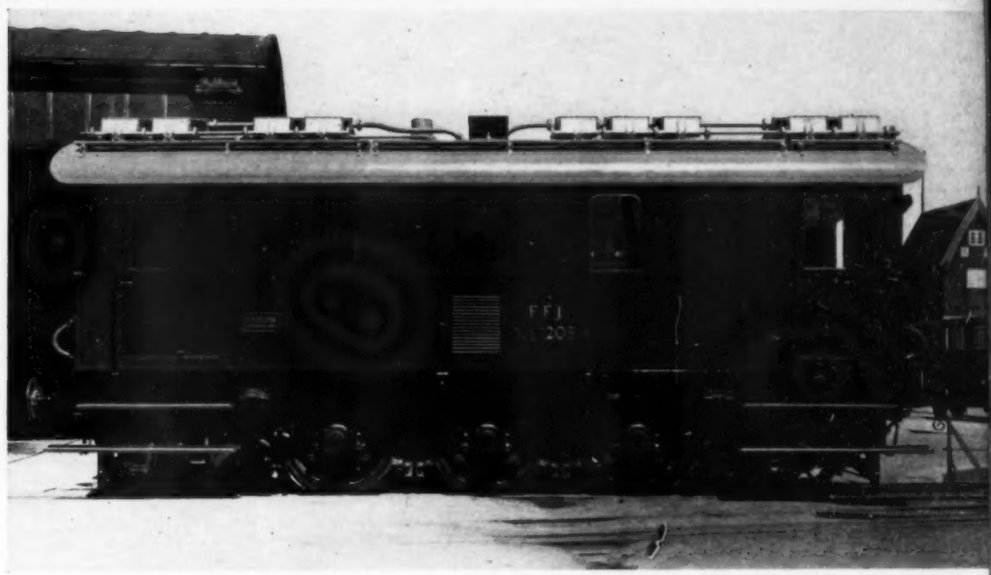
In the course of the last few years France's neighbor, Belgium, has also been busily Dieselizing her railroads, and the latest additions are actually the product of a Belgian manufacturer. Constructed by the S. A. Baume et Marpent, of Haine St. Pierre, they are triple-coach streamlined cars capable of exceeding 83 mph.

with a complement of 229 passengers. Three makes of engines are used of between 400 and 500 bhp., each train having two power units and electric transmission. The Belgium Carels engine is a straight eight of 40 litres capacity, the Danish Frichs unit a new 51 litre V-12, and the German Mercedes a V-12 of 50 litres capacity. All are four strokes.

As already mentioned, Denmark is changing over as rapidly as is economically feasible to Diesel rail traction, and in a very short time intends to abandon steam completely. There are now 39 private railway companies in Denmark, besides the State Railway, and the majority of these small enterprises would be unworkable without Diesel traction.

In 1935 there were 300 railcars or locomotives equipped with Diesel engines in service, each covering at least 25,000 miles per day. One batch of 275 steam locomotives owned by one of the larger companies traveled 3,114,515 miles during 1934, yet in 1935, after reducing the number to 175 and changing over to Diesel power, the yearly mileage was increased to 9,816,112.

The leading Danish railcar manufacturers and perhaps the most important in Europe today are Frichs, of Aarhus. Just recently they have been particularly busy with a number of new locos and railcar engines, and are now dealing with orders from all over the world. One of their most popular machines is the 1,100 bhp. 4-engined quadruple coach streamlined railcar, designed for express passenger work, and supplied in large quantities to the Danish State railway. These trains are about 274 feet in length, and can carry 222 passengers at speeds of up to 75 mph. The engines are sturdy 4-stroke 6-cylinder units devloping from 250 to 275 bhp., each one driving a D.C. generator.



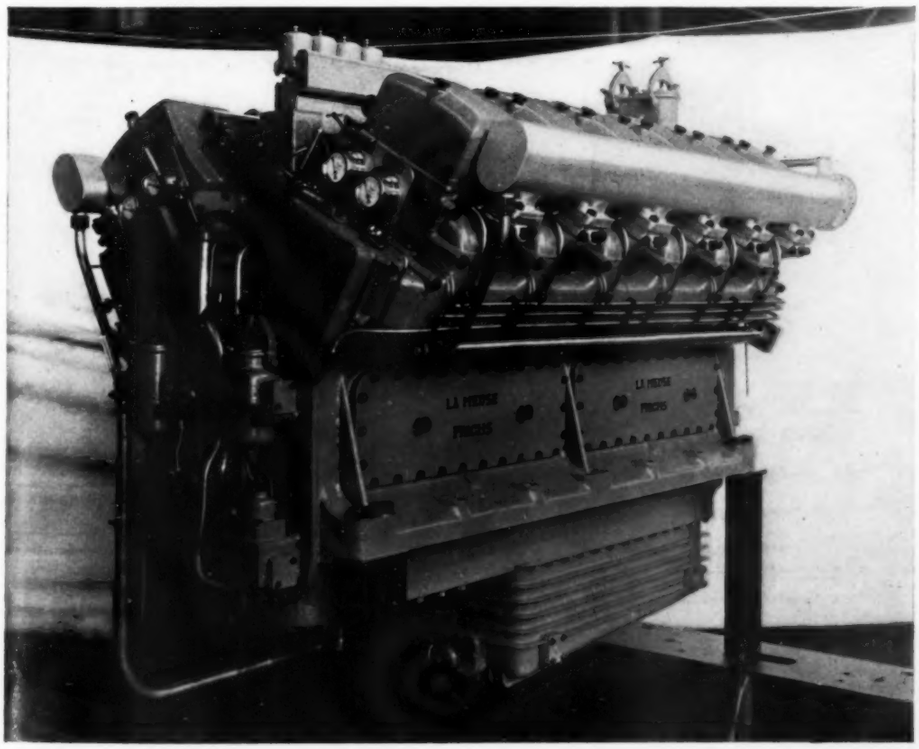
The 450 bhp. Frichs Diesel electric locomotive. Used chiefly for freight work.

Another interesting machine is the new 450 bhp. loco built for the Aarlburg Railway Co. This also has electric transmission, the generator having a capacity of 275 kw. at 650 rpm. The speed when pulling 100 tons on a straight horizontal track is 42 mph., or 31¾ mph. if the load is increased to 300 tons.

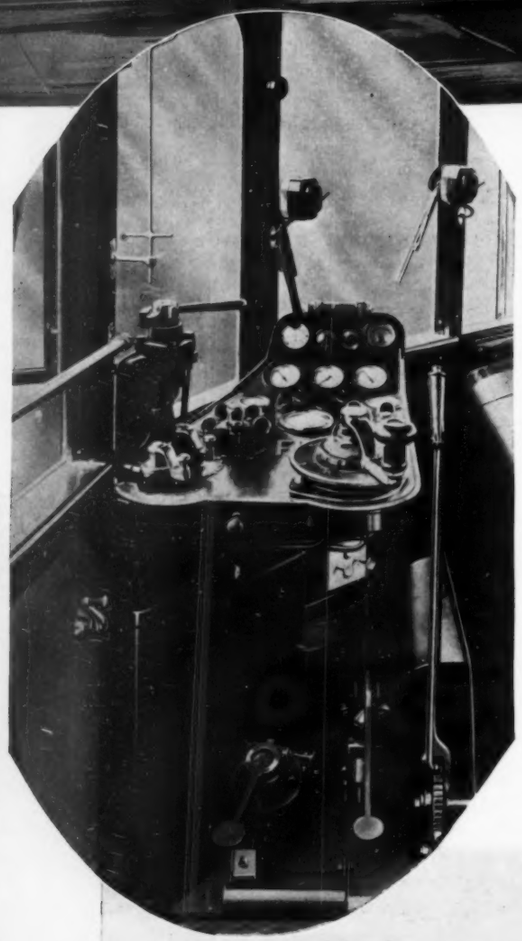
Since the beginning of this year the Italian railways have added enormously to their Diesel-engined rolling stock. There are now something like 220 high-speed railcars in use in Italy, and during the last month alone the Fiat works at Torino received orders for 20 Diesel-electric streamlined cars for the State Railways.

The new Fiat trains are of the three-coach type fitted with 2 Fiat 12-cylinder engines developing 400 bhp. at 1,500 rpm. Each train has a baggage room, post office and kitchen, and the windows are permanently closed, air conditioning being used throughout. A maximum speed of over 100 mph. is claimed with a service speed of 70 mph.

Up to the present the standard Fiat railcar was the Littorina, a single-coach design built



New V-12 Frichs 440 bhp. engine for Baume & Marpent streamlined express Diesel trains. A fine piece of engineering craftsmanship.



Latest type Littorina 48 seater railcar. Control station of Fiat Littorina railcar. 80 seater 240 bhp. twin engined Littorina railcar. Maximum speed 75-80 mph.

in various sizes, seating from 48 to 80 passengers and powered by one or more engines of 120 bhp. Incidentally, a 240 bhp. 80 seater coach of this type has a maximum speed of 80 mph., weighs 28¼ tons, and has a fuel consumption of 4½ mpg.

At the time when the last London Letter on rail traction was written, some ten months ago, a detailed description was given of the British A.E.C. railcar as used by the Great Western Railway. The Leyland Motor Co. of Leyland, Lancashire, Britain's other great commercial vehicle manufacturers, have also produced a small railcar and, although not as large as the A.E.C., it has proved very successful on the branch services of the London and North Eastern. The 130 bhp. engine used has 6 cylinders of 4⅝" bore and 6" stroke, and is of particularly sturdy construction. It is coupled direct to a Leyland hydraulic torque converter, from whence the drive is taken to one set of the two pairs of wheels. The engine is slung centrally from the chassis, starting being effected by a 24-volt starter motor.

An interesting point is that the brakes are fitted as in automobile practice and are of the internal expanding type with fabric lined shoes. The whole chassis assembly is beautifully finished and, although not revolutionary in design, is based on well tried principles. The body work reflects this, too, the passenger space being free from all vibration and really luxuriously appointed.

As regards fuel consumption, on a test run from Preston to Carlisle and back, involving the ascent of the famous Shap incline, this was at the rate of 13 mpg. The seating accommodation provides for 40 passengers and the driver, and at the maximum governed speed, 56 mph. is possible.

40 seater Leyland railcar on test run on L.N.E.R. Chassis layout of 130 bhp. Leyland railcar. Note central location of engine.

Below — Interior of Leyland railcar.

News from the Railroads

The 1936 budgets of the six principal French railways provides for an addition of 165 Diesel railcars and three streamlined trains.

The total distance covered by the 300-odd Diesel railcars (excluding streamlined trains) now in operation in France is about 12½ million miles annually at an all-in cost of 13 to 24 cents per mile.

One of the longest regular runs made by our European Diesel train is that between Berlin and Munich. The average speed maintained for the 408 miles is 62½ mph., and the time taken 6½ hours. Previously the best for this route stood to the credit of a steam train, which took over 9½ hours for the journey.

On May 15 a new express railcar service was inaugurated between Cologne and Berlin via the Wupper valley. The distance between these two towns is 360 miles, which is covered regularly in 5 hours at an average speed of 72 mph. A number of stops are made en route.

In March of this year a German triple coach Diesel railcar powered with two 600 bhp. supercharged Maybach engines reached a maximum speed of 129 mph. between Berlin and Hamburg. This is a world's record.

It is interesting to note the difference in trend in railroad development of the Diesel application in Europe and this same development in the United States. In Europe the trend is still to railcars, buses on rails so-to-speak, whilst in the United States the trend is obviously to larger and larger complete Diesel trains and larger and larger main line Diesel locomotives. The production of railcars in the United States, either gasoline powered or Diesel powered, seems to have practically stopped.

Euclid pneumatic tired dirt trucks working in conjunction with an Adams elevating grader. An Allis-Chalmers LO tractor furnishes the pull.

DIESEL DIRT MOVERS

By F. HAL HIGGINS

REMEMBER the ad that started out with this line: "They laughed when I got up to speak, but . . ."?

Well, I've seen it happen in the case of rubber on wheels in both agriculture and heavy construction over the past three years. I've just returned from the site of the Imperial Dam, just above Yuma on the Colorado River, where I saw in the heavy construction field what I had seen happen in the farm machinery field for the past two years: the triumph of the wheel over tracks via big rubber tires – air tires, the farm tractor boys call them – in the heavy construction field. It was an eye-opener, though I had been preparing for it from my personal observations in the farm fields of the Pacific Coast for the past twenty-four months.

But go back three years ago last November to the day after the New Deal swept into office on that great depression bottom of the fall of 1932. It was at the National Corn Husking Match held that year in a field in north central Illinois. There were some 60,000 farmers looking on and several million more listening to the radio. Air tires were making their debut before the American farmer after a year of sporadic successes in chosen spots in Florida sands and tests at the Ohio State University. Hopes were high in the breasts of the rubber manufacturers, and practically every make of wheel tractor was on exhibit wearing brand new "rubbers" of one of the two brands that were already fumbling with the idea that farm wheels could go places faster and easier if shod with pneumatic tires of comparatively low pressure.

However, Nature took a hand in this show of the bounding babies of rubber's depression researches and practically bounced the idea out of the field before the day was over. A rainy night, followed by freezing weather, put a crust on the mud just heavy enough to give them no foothold. As a consequence, the makers of track type tractors did all the pulling worth while that day and the farmers merely paused to smile and offer an occasional wisecrack about the place of rubber tires on farm tractors. But the funny part of the story is that neither rubber manufacturers nor one of the leading wheel tractor makers, who happens to make both track and wheel tractors, took that day as the final answer. Studies of treads, weights on wheels, speeds, etc., went ahead – and the farmers kept right on buying air tires for tractors until one out of every ten wheel tractors is now wearing rubber and the percentage in new sales runs up to 75 per cent and 80 per cent in whole states like California, where more farm tractors per 100,000 cultivated acres are used than in any other cultivated area of the world.

While I had been away from the heavy construction field east of the Rockies for two years, nothing in this nature had come to my attention on the Pacific Coast, though I had seen practically every big job over and over – Grand Coulee, Bonneville, Colorado River Aqueduct, All-American Canal, San Francisco-Oakland Bridge. Yet, *Construction Methods* and some other eastern publications were carrying more and more makes of big wheels wearing low pressure air tires in dirt moving, a field that the West had taught me belonged solely to the track type tractor. Finally, last fall, I saw tried out in the woods an air-tired logging arch. It was still an experiment, but it looked as though it might be standard one of these

days. Speed and less wear on the machine or implement is the answer. All farm machinery and implements except disks will soon be on rubber behind rubber-tired tractors on wheels, the unprejudiced students of farm equipment are now pretty much agreed.

But back to Condon's job on the Colorado River above Yuma. Here the West saw for the first time on a big dirt-moving job air tires replacing tracks for short hauling of dirt. The elevating grader is, of course, also something of an innovation on a West Coast job, as that machine was also supposed to be for the prairie and southern states.

Mr. George W. Condon himself arrived from Nebraska the second day I visited this job with Photographer Orville Logan Snider, who recorded it in movies. With Mr. R. M. Connor, superintendent for Morrison-Utah-Winston, he was checking over the job when we met him.

"It's good equipment," summarized Mr. Condon at the end of his analysis of what had happened in the contracting field during the depression and while coming out of it up to the present.

"We've been using this Euclid equipment in Nebraska for more than two years now; in fact, we used the first unit down in Kansas in February, 1933. We moved some 5,000,000 yards of dirt on the Sutherland, Columbus and Spencer dams in Nebraska with this kind of

. . . . *And now please turn to page* 48

The business end of an oil powered Northwest shovel loading three of the five Euclid "Trac-Truks" along the Colorado River near Yuma.

PORTUGAL'S BRITISH BUILT SUBMARINES

IN the course of the last four years the naval yards of that great British combine, Vickers-Armstrong, Ltd., have constructed three medium-sized Diesel powered submarines for the Portuguese government. They are all of the same size and design and well represent modern European trends in this class of war vessel. The last of the trio, the *Golfinho,* was delivered in May, 1934, making the trip from Barrow-in-Furness to Portugal non-stop.

Of all the types of fighting ships in use today none is more formidable than the submarine. Even in the early days of the German U-boats, when their range was limited, their armaments small and their performance uncertain, the damage caused to the Allied fleets was tremendous; totally out of proportion to the size and cost of the boats. Now that the original designs have been perfected, ranges increased, armaments more than doubled and reliable performance assured, the submarine has added a hundredfold to its importance as a naval weapon. Appropriately enough, it is the development of the Diesel engine that has made this possible.

Returning to the Portuguese boats, these are all 227 feet long with a beam of 21 feet and a depth of 12½ feet. Power is provided by two 8-cylinder 4-stroke single-acting Vickers-Armstrong Diesels of 14.6″ bore and 15.4″ stroke. At a useful maximum speed of 500 rpm. they develop a total of 2,400 bhp., which is sufficient to give the boat a speed of 21 mph. The full throttle range is 2,080 miles, but by reducing the speed to 12 mph. this is increased to 5,000 miles. Below surface 8 miles can be covered at full speed or 110 miles at 6 mph. The displacement is 1,000 tons and normally a complement of 38 men is carried. The armaments consist of one 4″ gun, 2 machine guns and 6 torpedo tubes (4 bow, 2 stern). Twelve torpedos are stored on board.

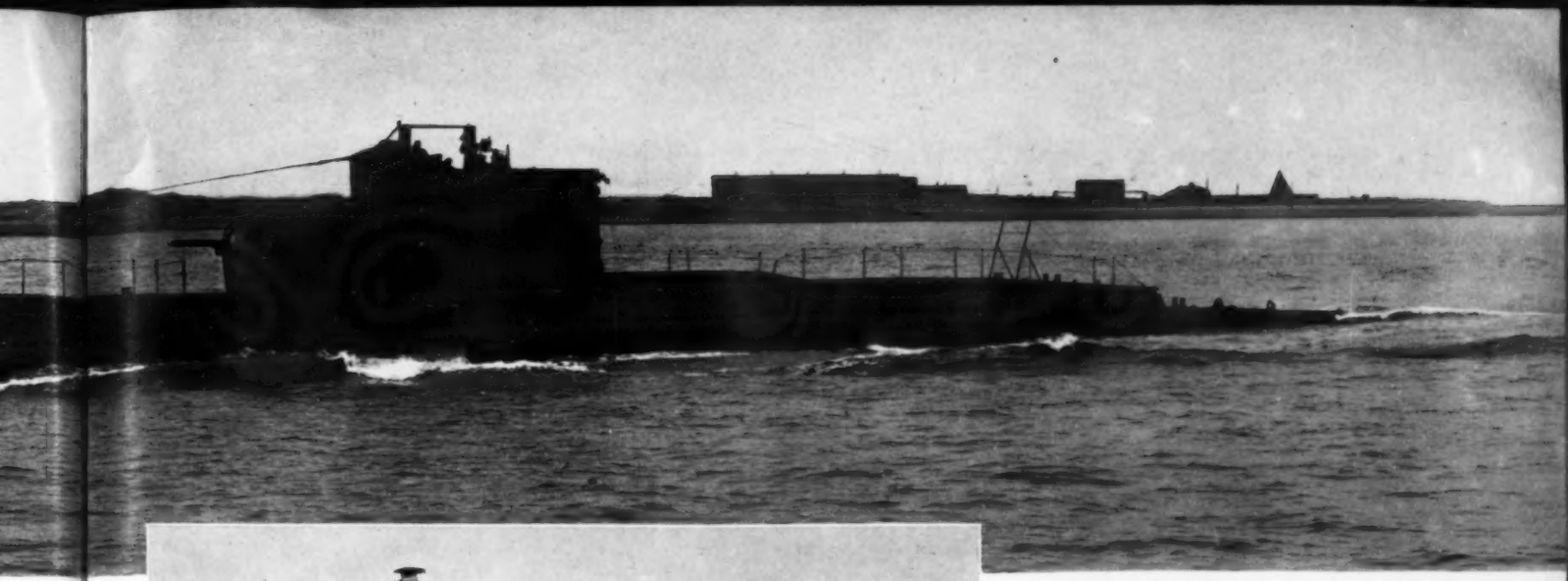
The Vickers engines which have made these boats such a success are very interesting pieces of machinery and are notable for their very low fuel and oil consumption and simple operation. As regards the fuel consumption, the minimum figure of 36 lbs. per bhp. hour has very few equals among this class of unit.

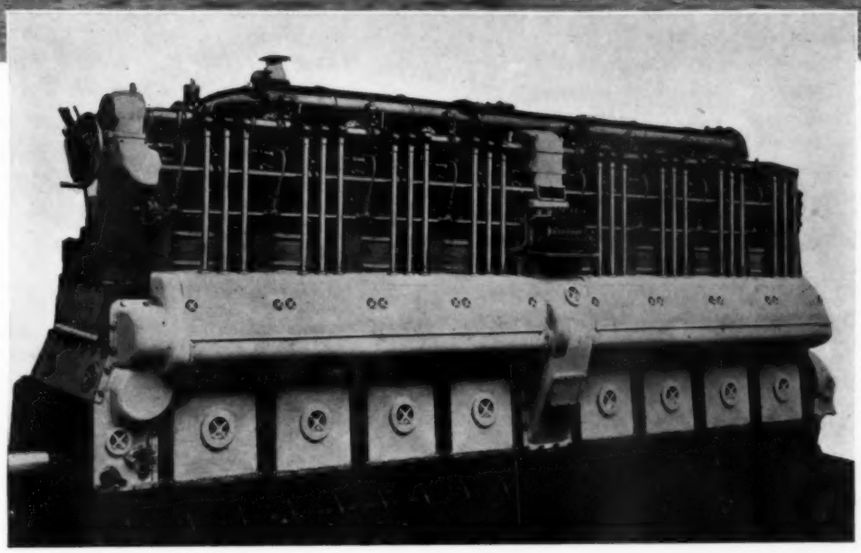
One very interesting constructional feature concerns the cylinder head layout. The cylinder heads are bolted together and are connected directly to the bedplate by stamped steel columns. These columns are of "H" shape, the front and back stamped vertical members being connected together by a plate at the top and a tee bar at the middle height, welded to the stampings. The heads are of cast steel with a combustion plate of forged steel welded to the body of the cover. Two inlet and two exhaust valves are fitted to each head. These valves are uncooled and are fitted in removable valve boxes, the exhaust valve boxes being water cooled by the circulating water discharged from the cylinder head. This water passes through the exhaust valve boxes and thence to the water jacket of the exhaust manifold.

The valves are closed by single conical springs. Light push rods and stamped rockers are used for operating the valves. The majority of the bearings of the valve gear are fitted with needle bearings, the only lubrication required being a little grease every few days.

Plain, concave-topped pistons are used, the material being special cast iron. The pistons are uncooled, tests including runs up to 200 bhp. under supercharge in a single cylinder trial engine having proved that piston cooling is not necessary up to the power required. Fully floating gudgeon pins are fitted, the piston bosses and connecting rods having plain bronze bearings. The connecting rods are steel stampings of "H" section, the big-end bearing caps also being steel stampings. The big-ends are lined with white metal and fitted with four high-tensile steel bolts.

Perhaps the most unusual point about the engine is the fuel injection system employed. A six plunger fuel pump, with suction valve control determining its output, is driven from the end of the camshaft. This pump delivers fuel to a fuel main or common rail from which a pipe to each spray valve is led, a shut-off valve being fitted at each branch. The spray valves are operated by push rods, the duration and timing of injection being varied according to the running conditions by eccentrics at the spray valves controlled by levers linked to a longitudinal shaft. For reversing engines of this size and speed Vickers claim that this injection system imposes less shocks than would cam-operated jerk fuel pumps, and results in





The submarine "Golfinho" at sea, powered with a 1,200 bhp. engine. Note camshaft piston and third push rod operating fuel valves. A clean and very efficient motor.

a simpler and more readily adjusted mechanism.

In service, Portugal's latest acquisitions have proved highly satisfactory. All three boats are running reliably and smoothly, no engine trouble whatever has occurred and, despite much hard usage by wind and wave, the machinery is still in perfect condition.

The rapid progress in developing faster, larger and more dependable submarines in Europe has naturally been followed closely by the U. S. Navy. It is interesting to briefly review the known activities of the U. S. Navy, in recent years, along submarine lines.

Approximately three years ago the new U. S. submarine program went into effect and to date sixteen new submarines of a vastly different type from our existing submarine fleet have been put under construction.

In addition to which six more submarines are called for in the new program for the fiscal year starting July, 1936, and bids for the Diesel engines for these six new vessels were opened in Washington on July 15th.

This makes a total of 22 modern, fast, dependable submarines to be added to the U. S. fleet. Several of these new submarines are now actually in service and giving a very good account of themselves.

When the U. S. Navy commenced this new sub program they departed from several old established precedents, the principal one was the discontinuing of Diesel engine building in the Navy Yards.

For a great many years now the Diesel engine manufacturers in this country have been contending the Navy should buy its submarine and other Diesel engines from established manufacturers. This fight has now, apparently, been won, because all of the submarine Diesel engines for the entire fleet of 22 submarines have been or will be ordered from American Diesel engine builders.

The first group of three new submarines, under the new program, calling for twelve engines, the contract for the Diesels went to the Winton Engine Corporation. On the second group, engines were ordered from Winton Engine Corporation; Fairbanks, Morse & Company and Hooven, Owens, Rentschler Company. On the third order the engine contract was split twelve engines to Winton and twelve to Hooven, Owens, Rentschler. Just as we go to press with this August issue comes word from Washington that the engine order for the six vessels in the 1936-1937 program has again been split, twelve engines to Winton and twelve to Hooven, Owens, Rentschler, with all auxiliary engines to Winton.

The electric equipment for this entire group of 22 new submarines forms a vitally important part of their equipment. Again the Navy has split the orders amongst commercial builders. The Elliott Company, through their Ridgway, Pa., works, obtained the generator equipment for twelve of the first sixteen vessels ordered. General Electric Company and Allis-Chalmers Manufacturing Co. obtained the electrical machinery for the remaining four subs under construction at this writing. It is yet unknown what dispensation will be made of the electrical order for the last six vessels.

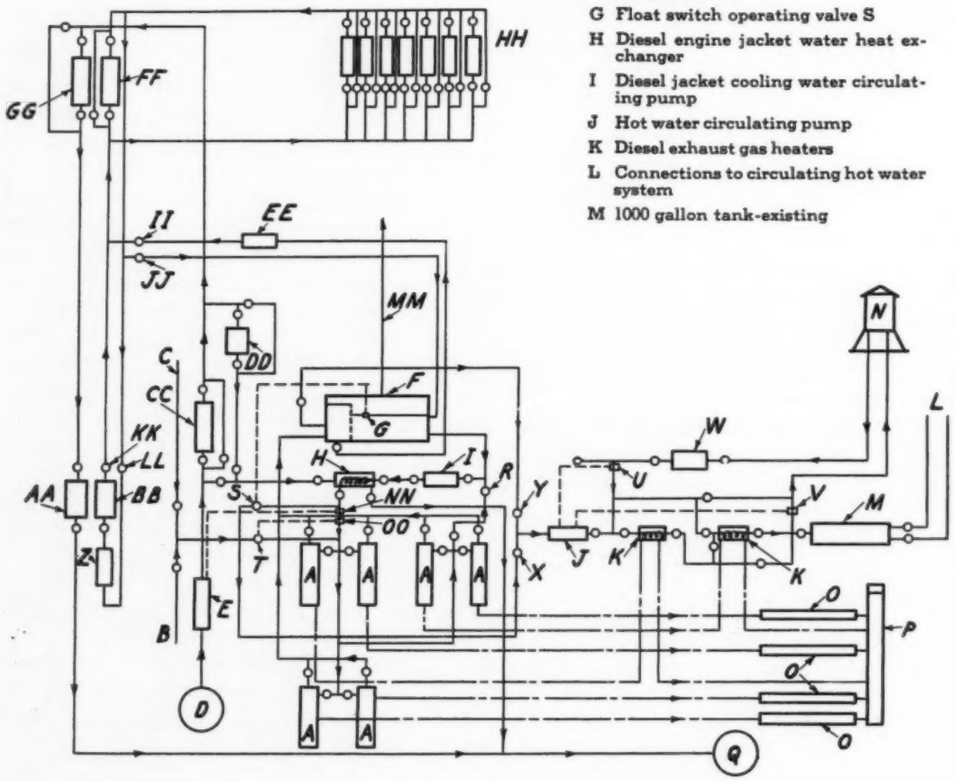
It is gratifying to know that the U. S. Navy has and is developing this important arm of national defense in so progressive a manner. It is to the credit of the Naval officials in charge of this program that they have developed, within our own commercial manufacturing organizations, a source of supply for Diesel engines and electrical equipment which will stand the Navy in such good stead in case of a war emergency.

WASTE HEAT RECOVERY IN NAMM STORE

By HUXLEY MADEHEIM and HENRY ROSENTHAL

IN the July issue of DIESEL PROGRESS the principal features of The Namm Store Diesel Plant were discussed but the recovery of waste heat was, of necessity, limited to two paragraphs. This article is intended to describe in much greater detail exactly how a portion of the waste heat from this Diesel plant has been used in connection with building heating and domestic hot water supply.

The reason for the installing of Diesel engines in this plant, as discussed in the other article, was their relatively high efficiency as compared with steam engines, which is important where all the waste heat cannot be used. However, even in the case of Diesel engines approximately only 31 per cent of the total heat in the fuel is converted into electrical energy. This thermal efficiency compares very favorably with the most up-to-date central station practices using high pressure, high temperature steam, and efficient condensing equipment. As compared with modern, moderate size steam engines operating from 100 lbs. steam to atmosphere, the Diesel engines, even with an efficiency of about 30 per cent, will produce about three times as much power from an equivalent amount of fuel. Even with this relatively high conversion of heat energy to work, approximately 70 per cent of the heat in the fuel is not available as electrical energy. Ten per cent of the heat energy is dissipated in non-recoverable electrical losses and radiation from the engines. The balance, approximately 60 per cent of the total heat of the fuel, is largely recoverable. Under ideal conditions approximately 80 per cent of the total heat of the fuel can be put to work. Of this 80 per cent, 30 per cent is the electrical energy referred to above and the other 50 per cent is heat recovered from the engine jacket water and from the engine exhausts.



Legend

A Diesel engine
B City water supply line
C Emergency line from existing roof tank
D Supply well
E Well pump
F 600 gallon tank
G Float switch operating valve S
H Diesel engine jacket water heat exchanger
I Diesel jacket cooling water circulating pump
J Hot water circulating pump
K Diesel exhaust gas heaters
L Connections to circulating hot water system
M 1000 gallon tank-existing
N 2000 gallon roof tank
O Diesel exhaust gas silencers
P Exhaust gas manifold to stack
Q Diffusing well
R Pressure controlled valve shutting off engine system from 600 gallon tank
S 1½" solenoid valve admitting make-up water
T 2½" valve admitting emergency city water
U Pressure control on hot water circulating pump J
V Temperature control on hot water circulating pump J to cut out pump below 120 degrees F.
W Pump to insure circulation
X Shut off valve
Y Shut off valve
Z Chilled water pump
AA Condenser
BB Water cooler
CC Booster pump
DD Engine room unit
EE Hot water pump
FF Chilled water coils for central fresh air unit
GG Well water coils for central fresh air unit
HH Seven chilled water coils for basement and first floor air circulation units
II Shut off valve
JJ Shut off valve
KK Shut off valve
LL Shut off valve
MM Overflow to sewer
NN Temperature control on well pump
OO Temperature control on valve T

Mr. Henry Rosenthal who, with his associate, Mr. Huxley Madeheim, acted in the capacity of consulting engineer on the Namm Store Diesel installation.

In the July article describing the plant, mention was made of the boiler installation in The Namm Store. These boilers were used in the past both for winter heating and for domestic hot water supply throughout the entire year. Due to the high inside heat load from both electric lights and people, department stores discontinue building heating much sooner than heating is discontinued in other types of buildings. Because of this condition, for over six months of the year one of these boilers was operating solely to supply domestic hot water for the building. Though this load is comparatively small insofar as steam requirements are concerned, yet the operation of the boiler required the attendance of a fireman and the consumption of a relatively large amount of fuel due to the low efficiency of the boiler when operating at such low ratings.

Besides the fact that the supply of hot water during the non-heating season was obtained with a great deal of waste, it was also true that the building heating, particularly on the main floor, was not satisfactory. This condition was due, in general, to the layout of modern department stores in which a large floor area, without partitions, is provided with a great many entrances. This condition makes it practically impossible to guarantee equal heating unless it is accomplished by heated air properly introduced to create a pressure in the space to be heated so as to counteract the effects of opening the doors.

An air conditioning installation was made in the basement and ground floor of The Namm Store, which was comprised in part of a number of units equipped with Aerofin coils and designed to supply chilled air so as to cool the first floor and basement in the summer. It was, of course, only good engineering design to provide for more satisfactory winter heating than had been possible heretofore, through the use of hot water through this same water circuit during the winter. The unique feature of the installation is the fact that it is possible to use waste heat from the Diesel plant rather than from the boiler to supply the hot water required for the heating of the first floor and basement. The transfer of this heating load from the boiler plant to the Diesel plant will result not only in a saving in fuel, but will also reduce the peak load on the boilers, which in the past have been severely taxed during extremely cold weather.

The details and methods employed to utilize the waste heat from the Diesel plant for the purposes outlined above are best understood in connection with the accompanying schematic diagram.

It will be noted that the primary jacket cooling system for the Diesel engines is a closed circuit including a 600-gallon surge tank, a centrifugal circulating pump I, and a heat exchanger H. Water is supplied from the surge tank to the centrifugal pump which delivers it through the heat exchanger to the various Diesel units, from which it is returned to the surge tank. The surge tank is installed just below the ceiling of the engine room. It is provided with an interior baffle which divides the tank into two compartments, which can overflow in either direction from one to the other. As will be explained in further detail, the compartment to which the returns from the Diesel units are delivered serves as a hot well and the compartment supplying the centrifugal pump serves as a cold well. During summer operation both sections of the tank are at substantially the same temperature, and the water from the hot well simply overflows into the cold well and is then cooled by well water in the heat exchanger before being conducted back to the engine jackets.

Domestic hot water is furnished to the building by the triplex pump J, which has a capacity of twenty gallons per minute. This pump receives its supply either through valve X which connects with the city supply line, or through valve Y which connects through a line to the surge tank hot well. When the connection to the surge tank is in service, water at approximately 130 deg. F. is supplied to the hot water pump. When the city water connection is used, the temperature of the supply to the triplex pump will be that of the city supply or generally below 70 deg. F.

Two of the five engines in the plant are equipped with exhaust gas water-heaters supplied by the Foster Wheeler Company. These heaters are shown in the diagram as K. Each has 134 sq. ft. of heating surface in ¾ in. diameter arsenical copper tubes.

The water from the triplex pump is delivered to the two exhaust heaters from which it can pass either into the 2,000-gallon roof tank, or to a 1,000-gallon pressure tank in the basement, which was in use on the old system. All of the hot water services to the building were supplied from this latter tank so that except for the connection from the new system to this tank, no new piping was required to connect the latter system to the hot water service lines of the building. At the same time, the use of this tank retained the steam heating coils in the hot water circuit. However, only in the event of failure of the triplex pump in the Diesel room will these steam coils be required.

While in normal operation, the two waste heat water heaters K are in series, but the piping arrangement is such that either of the heaters may be by-passed for cleaning or repair without losing the supply of hot water from the Diesel room. The size of these heaters is such that when water is taken from the surge tank hot well, adequate temperature is maintained on the domestic hot water supply with only one of the units in service.

The hot water pump is automatically controlled by both the temperature of the water leaving the water heaters and by the level of the water in the roof tank, the latter being the primary control. Thus, when the water in the roof tank is drawn down to a predetermined level the hot water pump will automatically start and when the tank is full the pump will automatically stop. This control is effected through a ¼ in. static line from the roof tank operating through a pressure switch in the engine room. Should this switch be in a position to operate the pump and the engines having the heat exchangers not be in operation, as might be the case nights and Sundays, the temperature control switch in the pipe at the outlet of the heat exchangers will automatically shut down the pump so that when the water is below the proper temperature it will not be delivered to the roof tank. Both the automatic controls have by-pass connections for manual operation. A thermometer is provided in the engine room to indicate the temperature of the water in the tank. Should this temperature be too high with the hot water pump taking its suction from the Diesel circulating system, tempering city water may be substituted through the connection previously described.

Because the operation of the triplex pump is either on or off, while of necessity the actual demand for hot water fluctuates, the water pumped at any particular time may be delivered entirely to the building or may be delivered entirely to the roof tank, or part may be delivered to the building with the surplus above building demands delivered to the roof tank. At such time as the pump is not operating, the entire building demand is supplied from the roof tank storage. As has been explained, the triplex pump is automatically started to replenish this roof tank supply when the level in the tank falls.

Most of the cleaning in the store is done at night when the load on the Diesel plant is relatively small and the small night engine which is not equipped with a water heater is in operation. The 2,000-gallon roof tank has a storage capacity sufficient to care for the entire night consumption of hot water so that there is always an adequate supply of hot water to the store.

It was necessary not only to provide a system for storing hot water but in addition it was necessary to guarantee continuous positive circulation through the waste heat water heaters to protect them against over-heating. This is provided automatically by the circulating system shown on the diagram. By means of this system, water is continuously pumped from the tank through the heaters and back again to the tank during that time that the triplex pump is not operating and either one of the engines with waste heaters is operating.

Thus, as shown in the diagram, in addition to the insulated hot water supply line from the heaters to the roof tank there is a second line which is uninsulated, and which is connected between the triplex pump and the heaters. The recirculation pump W equipped with a ¼ hp. motor is installed in this line which completes the re-circulation circuit. This motor is interlocked with the starter of the triplex pump and with oil pressure relays on the two Diesel units with heat exchangers, so that the circulating pump operates as explained in the preceding paragraph.

As has been explained, the surge tank for the Diesel jacket water supply is divided by a diaphragm into two compartments, into one of which the hot water from the Diesel jackets is discharged. When the heating system is not operated this water spills over the baffle to the cold portion of the tank and is recirculated.

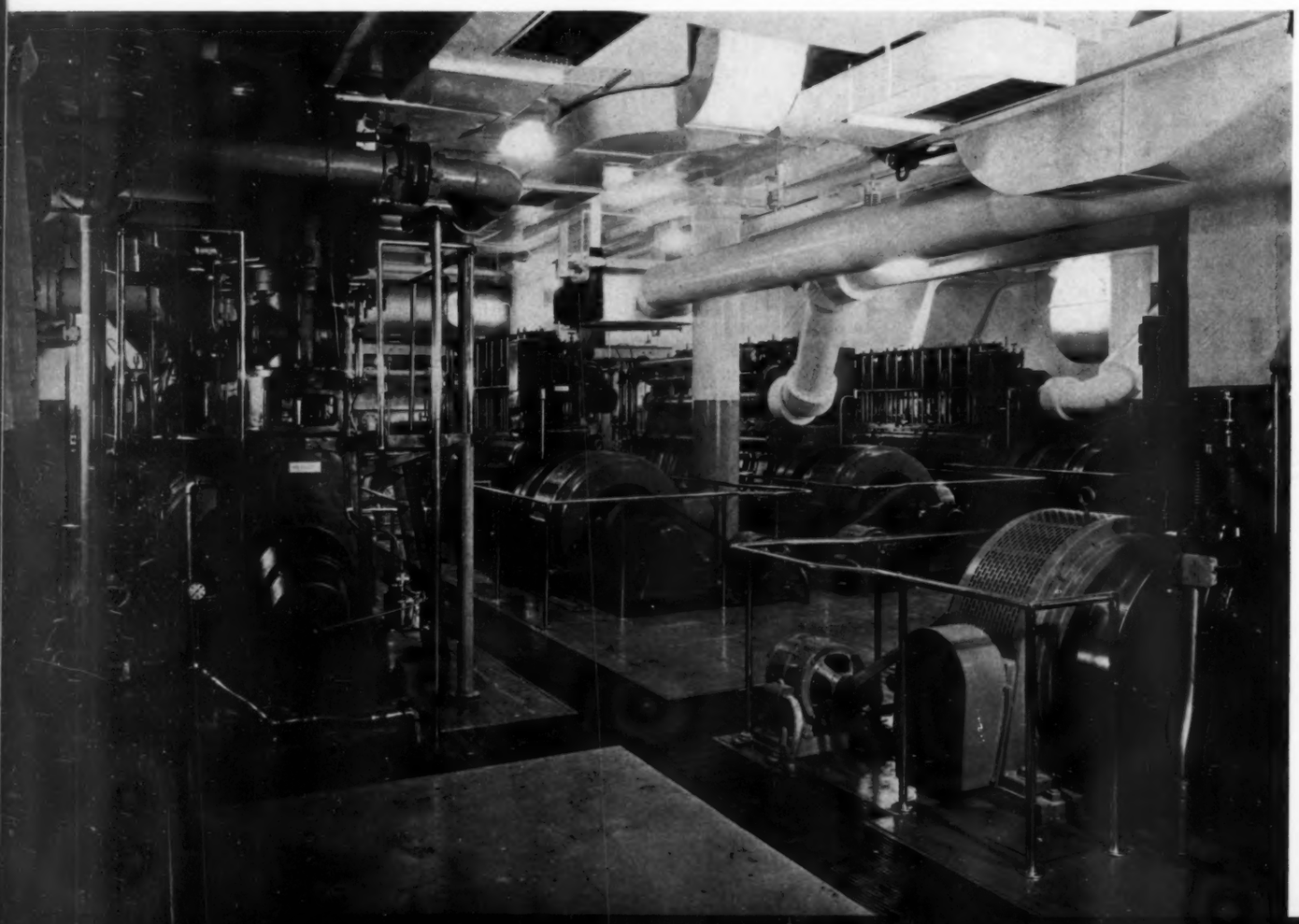
In winter, instead of spilling over the baffle the water will be withdrawn from the hot well through a 3 in. pipe by the hot water pump, which will deliver 250 gallons per minute to the water circulating piping of the air conditioning system. This water is passed through the chilled water coils of the central fresh air unit of the air conditioning system as well as through the coils of the various recirculation units located throughout the first floor and basement of the store and is returned to the cold well of the Diesel surge tank.

Valves II and JJ are closed in the summer to isolate the hot water section of the air conditioning system from the cold water section which will then be operating. In the heating season these valves will be opened and valves KK and LL, which isolate the chilled water section, will normally be closed. However, only one of these latter valves need be closed to prevent circulation of the hot water through the water cooler and the chilled water pump, as there will be no refrigerant in the water cooler, provision having been made for withdrawing Freon from the system and storing it during the winter months.

As water for the Aerofin units is drawn in the winter directly from the Diesel surge tank hot

. . . . *And now please turn to page* 45

General view of the Namm Store engineroom looking from the sub-base for the sixth Worthington Diesel which will be installed at such time as future load requires. One of the Foster-Wheeler exhaust-gas heaters is visible suspended from the ceiling.



A close-up of the new unit, a Worthington 450 hp. 6-cylinder 13¼" x 7½", 4-cycle, 327 rpm. Diesel engine, driving an Elliott 300 kw. 80 per cent p.f., 2400-volt generator, with a direct-coupled 10 kw., 125-volt exciter.

FORD CITY, PENNSYLVANIA

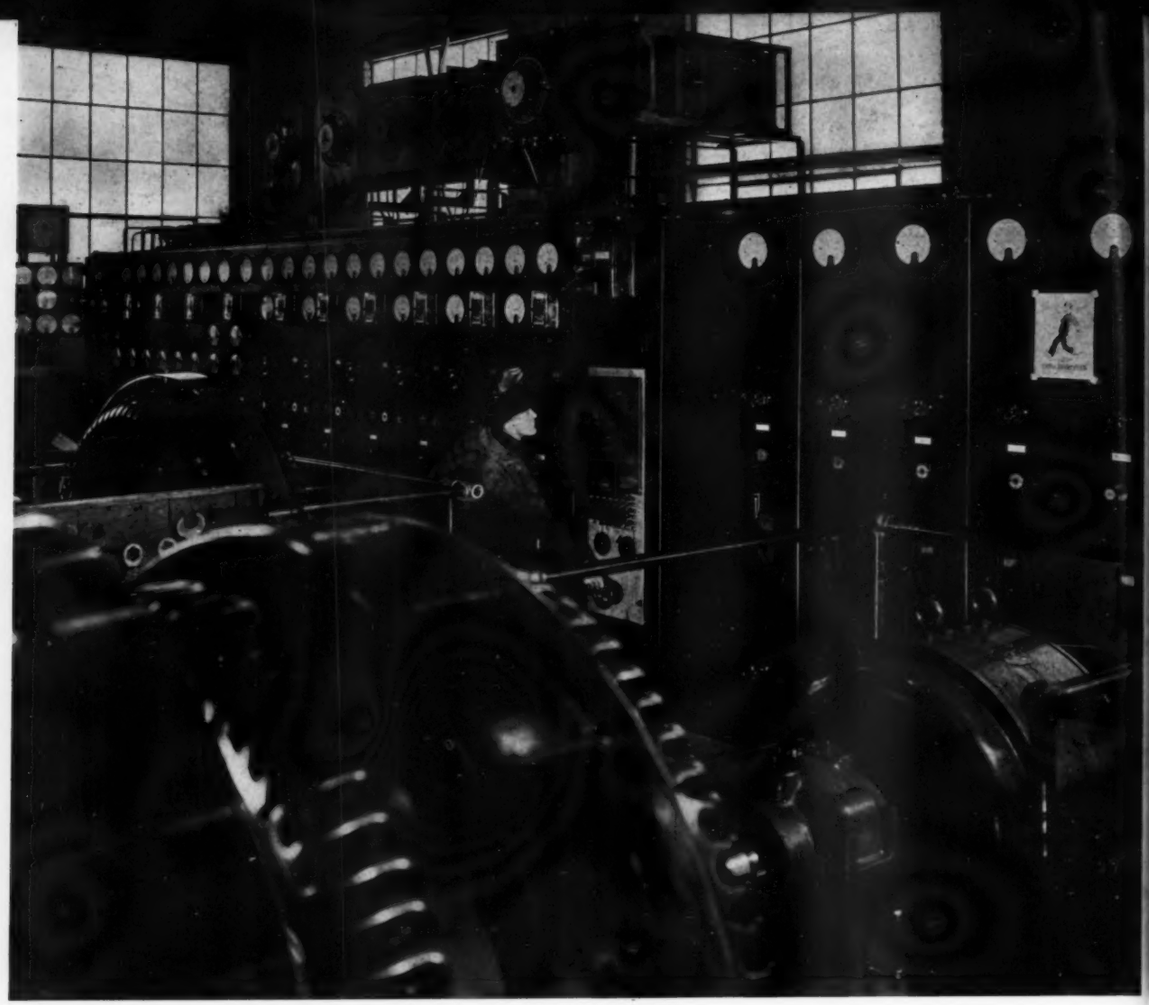
By JOSEPH BRESLOVE, *Consulting Engineer*

THE Municipal Power Plant at Ford City, Pa., has just recently placed in operation its second Diesel unit. This municipal plant, with a long record of successful operation, is outstanding even amongst the most successful, in that the latest addition to its equipment was paid for from profits, and no bond issue was necessary. Coming at the tail end of a serious depression, this is an enviable record. There is no indebtedness on the power plant.

The Ford City electric plant began operations 36 years ago, generating its power entirely with gas engines, using natural gas as fuel. Being located in the center of a natural gas field, it enjoyed, for many years, a plentiful supply of cheap fuel. Of recent years, however, the supply has become less plentiful, and with the increased cost of production, the point has been reached where gas is no longer the most economical fuel for power generation. Fortunately, the rapid development of the Diesel engine during the past few years has made it a most economical and dependable unit, unique in its ability to serve the small and medium-size power station. It was, therefore, in line with the modern trend for the more recent installations at this plant to consist of Diesel units.

Mr. Joseph Breslove, well-known consulting engineer of Pittsburgh, Pa., and Cleveland, Ohio.

The Diesel engine is particularly well adapted to serve the small plant. Requiring no "warming up," it can be started from cold and connected into the line in a few moments. There are no standby charges, and with the prevailing price for fuel oil it generates a kilowatt-

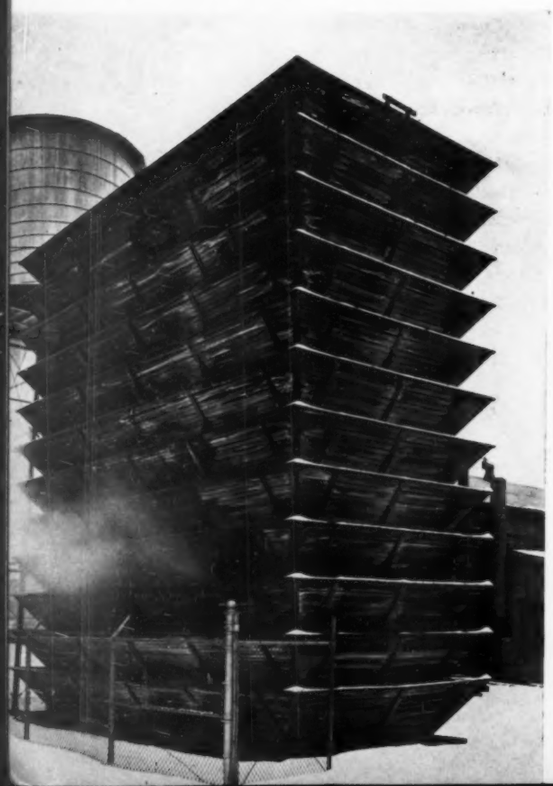


The switchboard, Elliott generator and exciter in immediate foreground.

hour at a comparatively low figure. It is excellent for emergency or peak periods, and where there is no demand for process steam or low-pressure heating steam, it is in many cases more suitable for the small plant than the steam boiler and engine, or turbine. The Diesel must not, however, be taken as a panacea for all the ills of power generation, and where coal is cheap, or other factors enter, it is not likely to supplant the steam unit.

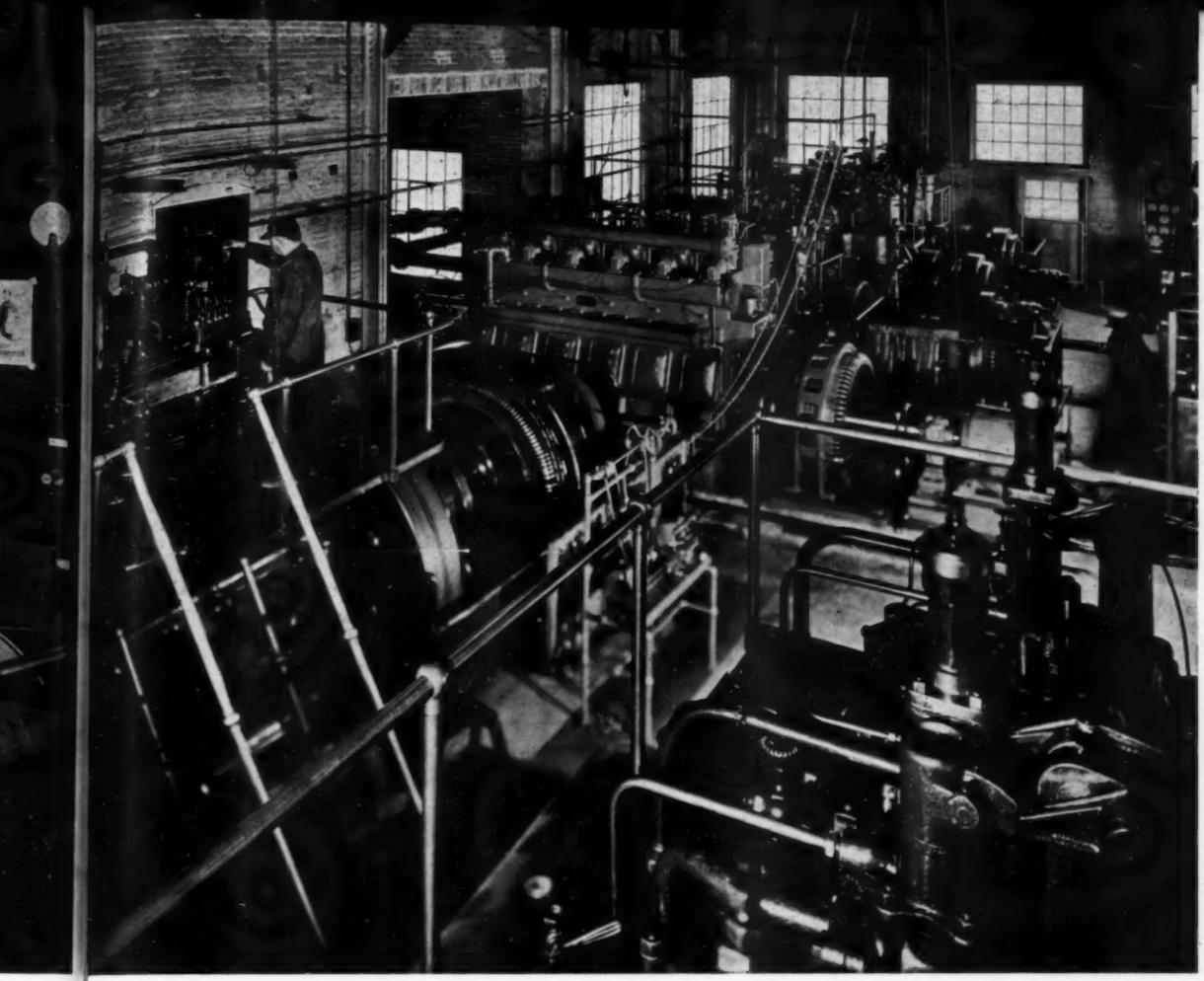
In 1931 the Ford City power house contained seven vertical gas-engine units, ranging in size from 65 kw. to 200 kw., all 3 phase, 60 cycle, 2,300 volt. Increase in station demand called for greater generating capacity, and since the price of natural gas was no longer attractive, a Diesel engine unit was decided upon. The size chosen was 500 kw., and it displaced two 65 kw. gas-engine units. At the same time, a complete new switchboard of modern design replaced the older and obsolete type.

The first Diesel unit is a Nordberg 3-cylinder, 2-cycle, 277-rpm. air injection engine, direct connected to an Elliott 500-kw., 80 per cent p.f., 2,400-volt generator, with a direct-coupled 125-volt exciter. This unit has been kept in practically continuous operation, with the gas-engine units used for emergencies and during peak load periods.



The cooling tower at the rear of the power plant building. Immediately at the right of the cooling tower next to the building is the vertical cylindrical exhaust silencer of the Worthington engine.

In the latter part of 1935 consideration was given to an additional Diesel unit. This was based on the necessity for additional station capacity to handle peak loads and for shutdown periods during which inspection and adjustment could be made on the Nordberg unit. Furthermore, load conditions demanded a unit rated at less than 500 kw. for night and Sunday operation. It must be borne in mind that the fuel consumption curve of the Diesel engine is steep on each side of its full-load point. In this respect, it closely resembles the slide-valve steam engine rather than its sister, the unaflow steam engine. In addition, the consumption of lubricating oil of the Diesel is an important factor in the cost of its operation, and this is practically independent of the load, the lubricating oil consumption varying with the size of the engine and the number of hours of operation. It is evident from these facts that the Diesel plant must be designed so that each unit is operated as nearly as possible at its rating. In other words, the "load factor" must be kept high for economy. Unlike the steam engine, its overload capacity is extremely lim-



The engine room at Ford City is well packed with generating units. This photograph was taken from on top of the Nordberg Diesel engine, the top of which shows in the lower right-hand corner of the picture. At the left is one of the gas engine units. In the middle of the picture, extending into the bay, is the new Worthington unit. Beyond it are three more gas engine units, and at the right, the switchboard.

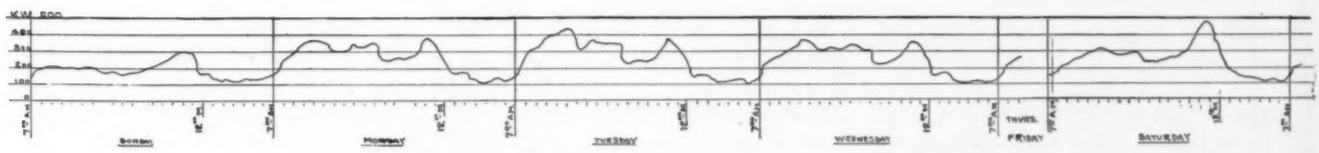
ited, and while it is customary to consider it as having about 10 per cent overload capacity for one or two hours, this must be used only in emergency or for short peaks, and is not to be recommended for continuous operation.

The load at Ford City is typical of the average small Eastern city, combining a large domestic demand with a fair industrial load. The Sunday load is light and there is usually a heavy Saturday evening peak. Winter conditions are usually about 15 to 20 per cent higher than summer.

The load chart (below) was taken during an average week in May, 1935, and the following table covers the total monthly kilowatt hours generated during the period from July, 1934 to July, 1935.

Month	*Kilowatt Hours*
July	133,400
August	140,900
September	142,500
October	149,000
November	162,600
December	177,500
January	171,500
February	157,900
March	154,000
April	145,700
May	141,700
June	134,600

A study of the conditions at Ford City indicated that the new unit should be of 300-kw. rating. The average hourly station load plotted against operation of the existing 500-kw. unit, and an additional 300-kw. unit showed that the smaller unit would carry the load from about midnight to morning and all day Sunday, with the larger unit operating the rest of the time; both units being in service during heavy load periods. The result would be about equal distribution of hours and a load factor of 57 per cent in summer and 63 per cent in winter. Somewhat better results are expected with increase in station demand. The indicated saving in fuel and lubricating oil is approximately $4,000 per year, to which must be added the intangible saving in maintenance, resulting from operating a smaller unit, and the availability of inspection and repair periods. One of the gas-engine units, rated at 120 kw., was removed to make way for the 300-kw. Diesel unit. . . *And now please turn to page 50*



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BENDIX REMOTE CONTROLS FOR MARINE USE

THE public has been educated to expect a flow of power by simply turning a switch. No attention is paid to the source of power provided the desired result comes. This involves two considerations. First, the source of power must be thoroughly dependable; it must be capable of carrying on its processes of operation without attention. Second, the control of the power flow must be complete. Frequently, it is convenient to have the source of power separated from the operator, requiring remote controls.

The Bendix remote controls applied to marine Diesel engines are a good example of this modern trend. In addition there is an important safety consideration because many a marine accident has been caused by a misunderstanding between the pilot house and the engine room. These controls give the helmsman the same degree of control over the engines as though he were right in the engine room. The entire control of the ship is in his hands. As for the Diesel engines, they are inherently automatic in operation. The processes of combustion, and power development, cooling, and lubrication are all under close mechanical control and require no attention from the operator. Safety devices are available for protection of the engines in case of accidents to the engine itself.

The helmsman must have control over the speed, and he must be able to start, stop and reverse the engines. The layout here shows a twin screw arrangement of Diesel engines with reverse clutches. It is understood of course that the controls are varied in detail to suit the individual installation, but in all cases they accomplish the same general overall purposes. The description of this equipment naturally divides into three parts, the power reverse gear shift, the speed control, and the control stands.

The power reverse gear shift consists essentially of an electrically controlled vacuum power cylinder connected to the operating lever of the reverse gear. The reverse gear lever must be moved into only three positions, either ahead, stop, or astern, after which no force is required to hold the lever in position, and it is preferably free, within certain limitations, to accommodate minor movements of the reverse gear mechanism without reapplying any force. The power cylinder has a double acting piston. Vacuum is obtained from

. . . . *And now please turn to page 46*

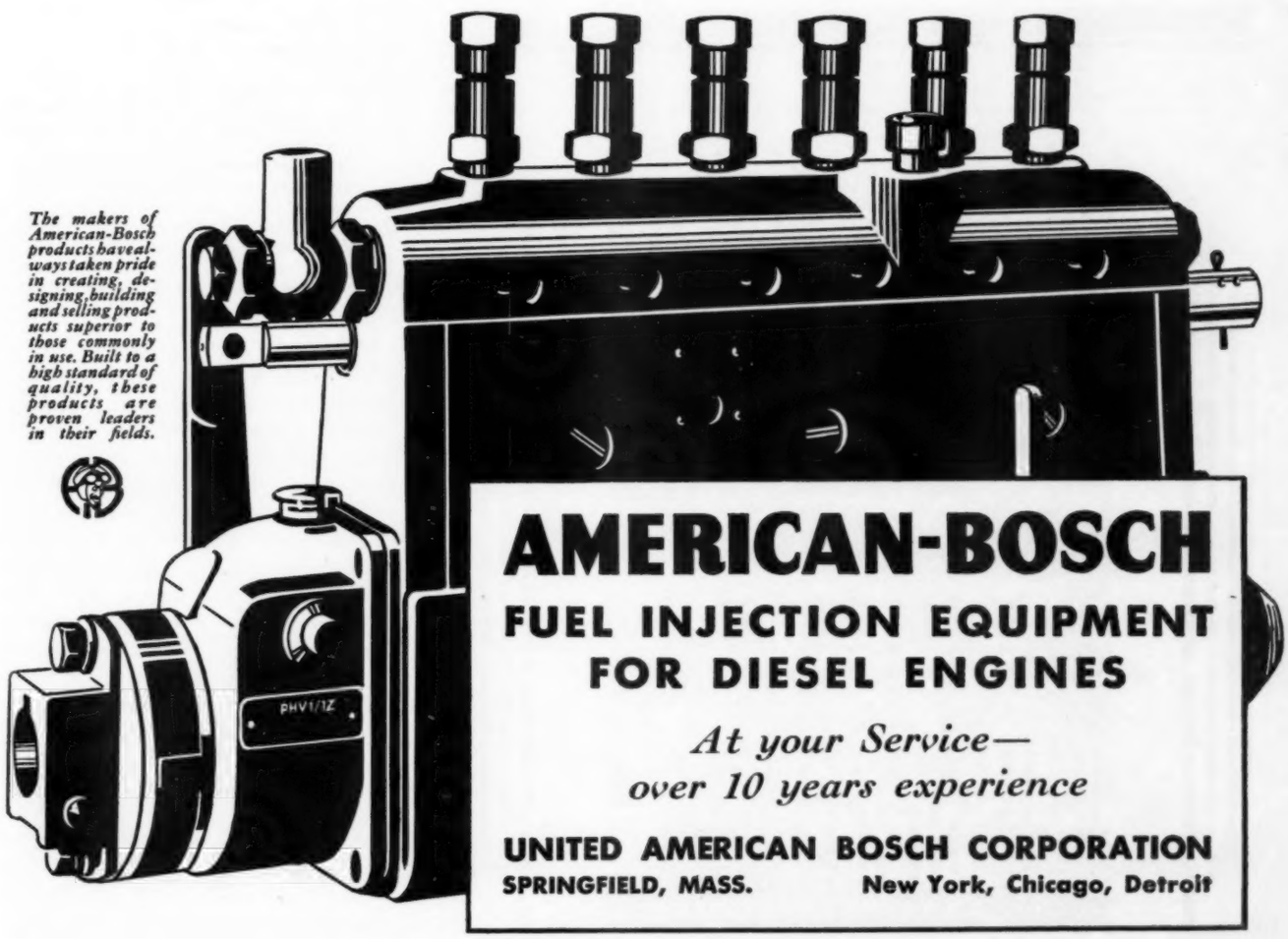
WASTE HEAT RECOVERY IN NAMM STORE

. . . . *Continued from page* 40 . . . .

well, which receives it directly from the Diesel jackets, its temperature will be between 130-140 deg. F. Sufficient surface has been provided in the various units so that with water of this temperature in the amount available, the first floor and basement can be adequately heated even with an outside temperature as low as 0 deg. F.

The cooled water, on returning from the conditioning units to the cold well portion of the Diesel surge tank, flows back to the Diesel circulating pump. In extremely cold weather it is expected that the water returning from the heating system will have been cooled sufficiently for re-use in the engine jackets without further cooling. At such time no water will be furnished from the supply well to the heat exchangers in the Diesel circulating system. Moreover, an adjustable speed fan has been installed on the central fresh air supply system which when speeded up, in addition to furnishing an added supply of fresh air to the store, provides added cooling on the Diesel jacket water. The number of days during which the total heat of the engine jackets may be absorbed by the heating system can be extended by this means. If, however, further cooling is needed on the water returning from the heating system, well water will be supplied to the heat exchangers as is required, the well pump being automatically controlled by the temperature of the water supplied to the engine jackets.

With the air conditioning as now installed it is expected that approximately 70 per cent of the total heat supplied in the fuel to the Diesel units will be usefully employed during the extreme winter days. Of course, a large portion of this will be utilized by building heating and the extent of its utilization will be directly dependent on weather conditions. Hence, with the air conditioning system being limited to the first floor and basement as now installed, there will be relatively few days during the year when full advantage will be taken of the available heat. Should the air conditioning system be extended it will be possible to conserve more of the heat contained in the exhaust gases and to utilize over a large number of days the entire heat of the jacket water. However, with the system even as now installed there will be an appreciable saving in fuel and reduction in labor and maintenance of the boiler plant due to the six-month shutdown now possible through the supplying of the domestic hot water from the Diesel system. The reduced rating on the boilers in the winter, due to the elimination of the heating load of the first floor and basement will permit one of the boilers alone to supply the remaining heat load of the store even in the extreme cold weather where in the past two boilers were required, and an appreciable saving in heating fuel will be effected.



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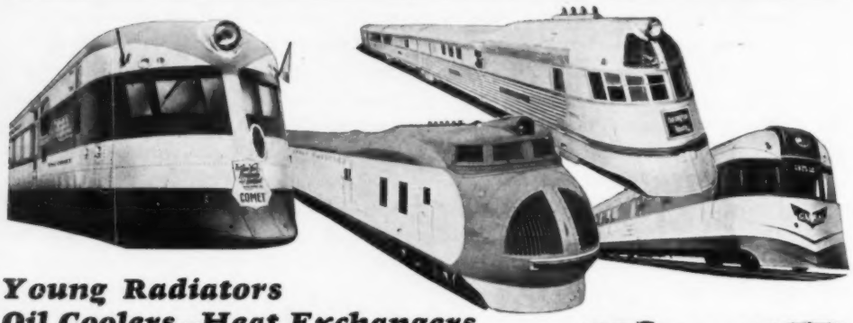

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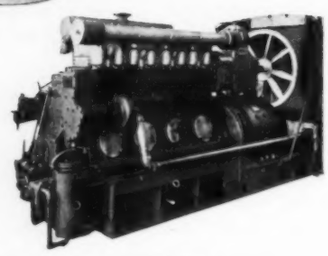

WHEREVER Diesel or gasoline engines are found in operation and cooling problems exist Young heat transfer products will be prominently associated. Built for any type of service they are cooling gasoline and Diesel engines from the smallest to the largest and in services ranging from the toughest oil field conditions to truck and coach service where appearance is a necessary feature.

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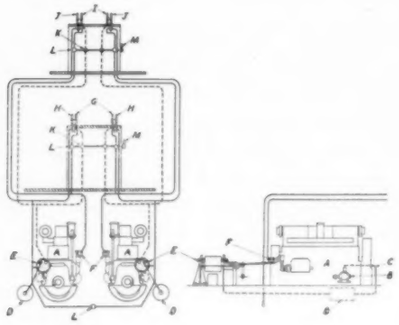
BENDIX REMOTE CONTROLS FOR MARINE USE

. . . . *Continued from page 44* . . . .

the vacuum reservoir, and the vacuum is maintained in this reservoir by means of the vacuum pump driven from the engine. The power cylinder is made large enough in diameter to give the force required to operate the reverse gear lever.



Legend

A Marine Diesel engine
B Vacuum pump
C Check valve
D Vacuum reservoir
E Vacuum cylinder for operating reverse gear
F Vacuum cylinder for governor and fuel pump control
G Pilot house reverse gear control
H Pilot house engine speed control
I Upper bridge reverse gear control
J Upper bridge engine speed control
K Cut out switch
L Shut off valve
M Operating lever for cut out switch and shut off valve

Two electric solenoids operate two valves which connect the closed ends of the power cylinder with the vacuum reservoir, or with the atmosphere. The solenoids are connected to the electric switch controls by wires. The controls are marked "Ahead," "Stop," and "Astern." When the control is moved to one of these positions, the proper solenoid opens one end of the cylinder to the vacuum reservoir, and when the piston has moved the reverse gear lever into the indicated position, a cutout switch breaks the electric circut and the valve reconnects that end of the cylinder to the atmosphere. Electric current is used only during the gear shift operation. The piston and connected parts are then under no load and are free to float and find their own centers (except in the case of the non-holding type of reverse gear where the valve keeps one end of the cylinder connected with the vacuum as long as the reverse gear is in use).

STREAMLINERS IN ITALY

. . . . *Continued from page 27* . . . .

motive set, including a Diesel engine of the Budd type built by the Officine Meccaniche at Brescia under license, having cylinders with a stroke of 170 mm. and a bore of 120 mm., with a capacity of 11.53 liters, an electric generator and an electric motor. Due to special arrangements made in the suspension of the above mentioned generating sets, vibration from this equipment is not transmitted to the body of the car. These motive sets may be controlled from each of the two drivers' cabins, as they are synchronized.

It is stated that also the Italian State Railways Administration is considering the opportunity of ordering Piaggio-Budd stainless steel rolling stock, including actual streamlined Diesel trains.

The use of streamlined Diesel railway rolling stock in Italy is becoming an accomplished fact with the delivery of the streamlined trains from the Fiat Works at Turin to the Italian State Railways Administration. These trains are to be employed on the Turin-Milan-Venice-Trieste line, and are to have Diesel engines with a weight of 5 kg. per hp. against a weight of 100 kg. per hp. in the steam locomotives. It is estimated that the streamlined design of the new Diesel trains has reduced to about 35 per cent the effort of traction in respect to the ordinary trains. The new Italian streamlined Diesel trains measure 60 meters in length and consist of three articulated cars. The two ends are laying on the driving bogies with the respective inversion device and bridge fitted with free wheel and stroke inversion apparatus. In the intermediate junction points the cars are supported two by two by a single bogie, and the bearing takes place by means of a pivot which allows the articulation. Between car and car there is only the room necessary for the articulation, which room is occupied by two large leather bellows.

At the two ends of the train there are the drivers' cabins and the traction engines. There are two traction engines of the Fiat Diesel type with 12 cylinders and a power of 400 hp. at 1,500 rpm. each. The two engines have a single control gear which may be operated from both drivers' cabins so that the train does not need to be reversed at the end of the trip. The train is provided with baggage room, post office, kitchen, toilet and room for hand baggage. An auxiliary Diesel electric generator supplies the electricity at 36 volts for lighting purposes, and an oil stove insures the heating during the winter season.

Since high speeds would not permit open windows, fixed glasses are provided in the new streamlined trains, and ventilation is made by means of a special air conditioning plant which allows the admission of air, its filtration and, according to the season, its heating or its cooling.

Eighty passengers can be accommodated in these trains in first and second class compartments. Each passenger has at his disposal a reversible table for meals. In order to insure comfortable riding at the highest speeds much insulation has been provided in addition to the ordinary bearings. These trains shall have a maximum speed of 160 km. per hour, and a commercial speed of 110-115 km. per hour. The trip from Turin to Venice is to be made in four hours, and the trip from Turin to Trieste in six hours.

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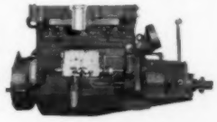
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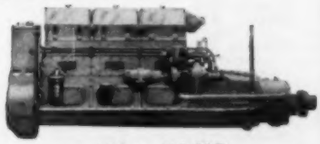
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DIESEL DIRT MOVERS

. . . . *Continued from page 35* . . . .

equipment the past two years. Besides we have done a lot of road building with it, too.

"The tempo of the whole contracting game has changed with the depression. The contractor has been up against so-called chiseling and price-cutting at the bottom of the depression, and the people letting the work naturally took advantage of the fact that there were more contractors than jobs and some of them would gamble on getting by at lower prices than were safe and sure, or would be satisfied with no profit in order to keep their organizations together for future jobs.

"Instead of an over-all price which we used to get, the people letting the jobs now pay only a flat rate. We formerly got one to two cents for each yard over 500. We now get about the same price, but the over-all has been dropped out. Speed has come on the scene, which brought wheels with big air tires to replace tracks, both as regards wagons and tractors that are taking the dirt away from the elevating grader to the dump.

"Contracting has changed very rapidly in the last ten years. Look at the amount of man labor required on a yard of dirt. Ten years ago a crew of 25 men was required to get 25,000 yards a month. Now 13 men get out 60,000 yards in that time. Wages are higher, but depreciation has increased. There's little change in price for moving dirt, but the job is speeded!

"A contractor today has to keep abreast of the times. That means the fastest time and the least man labor to get a yard or a million yards of dirt from here to there. The equipment plus the management is the combination that solves the problem. Equipment is continually coming on the scene to junk the equipment already in use. My superintendents and I must immediately adopt such of this equipment as will fit into our jobs to keep cutting costs by speeding the moving of that dirt. If a contractor doesn't or can't do this, he finds himself left sitting on the sidelines while younger men with faster tempo for meeting changed conditions get the jobs – and the gravy – if any!"

Mr. Condon's equipment on this job includes a Northwest shovel powered by a Twin City oil engine with a fleet of five Euclid "Trac-Truks" hauling from it, an Adam's elevating grader mounting a McCormick-Deering engine for belt power and pulled by an Allis-Chalmers LO oil tractor. Two more Allis-Chalmers LO's with bulldozers level off the dumps. A Caterpillar Diesel road maintainer is kept busy running over the roads followed by loaded trucks. The two fleets of Euclid transport units are divided into five 6-yard Trac-Trucks at the shovel and seven 8-yard tractor trailer wagons hauling from the elevating grader. We saw the trucks getting their loads from the shovel in 45 seconds, a 2½-yard bucket being swung.

"I guess we've seen the start of a revolution in the West," I mumbled to Cameraman Snider as we trudged off the job at the end of the second day. "If these short-grass Irish contractors can come out here and show our Californians how to trim a third off the cost of moving dirt, we've seen something down here on the silvery Colorado that will go echoing up and down the Coast for the next few years. Looks like the dirt-moving field is going along right in step with the farm tractor and machinery industry in speeding up by putting on rubbers."

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Appendix

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FAIRBANKS MORSE REPORT

FAIRBANKS, MORSE & COMPANY and subsidiaries for six months ended June 30, 1936, reported a net profit of $786,614 or $1.35 a common share. For same period last year the company reported a net profit of $376,990 or 40 cents a share.

THIRD ANNUAL WEST COAST SHOW

THE Third Annual West Coast Diesel Show, held in Los Angeles between June 13 and June 20, was the largest Diesel engine show in the history of the country. Over 70,000 attended it, and for the first time publicly exhibited on the Pacific Coast were Diesel powered passenger cars, along with approximately seventy-five exhibitions by manufacturers and dealers of Diesel engines.

One of the passenger cars was driven from Vancouver, B. C. to Los Angeles by Mr. C. D. MacKinnon, Manager of the Hemphill Diesel Engineering School, in Vancouver, B. C., and his total fuel cost for the 1,630-mile drive was $2.65. He drove down in approximately 3½ days, which is considered good time with any gasoline powered passenger car.

The Diesel engine manufacturers and agents on the Pacific Coast were the joint sponsors of the Third Annual West Coast Diesel Show with the Hemphill Diesel & Engineering Schools, Inc. It marked the opening of the new and enlarged quarters of the Hemphill Diesel Schools. The new structure is one of the most impressive in Los Angeles, and added a modern touch to the entire exhibition.

Exhibitors included Fairbanks-Morse Company, Nordberg Manufacturing Company, International Harvester Company, Sterling Motor Truck Corporation, Covic Diesel Engine Company, Lubco Corporation, Western Enterprise Engine Company, Worthington Pump & Machinery Company, Shell Oil Company, Caterpillar Tractor Company, Cletrac Tractor Company, Moreland Motor Truck Company, and many other firms holding equally outstanding positions in the Diesel field. The committee in charge of the Diesel Show was headed by Mr. Ralph Hemphill, President of the Hemphill Diesel & Engineering Schools, Inc., along with members of the Diesel engine industry located in Los Angeles.

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By J. W. ANDERSON

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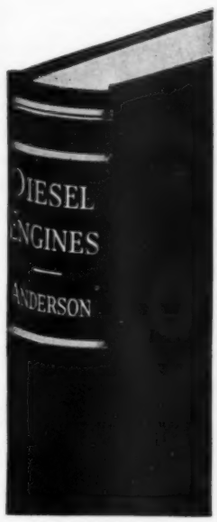

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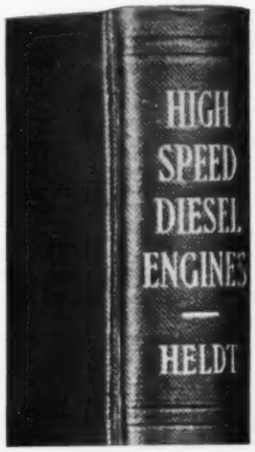

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. . . . *Continued from page 43* . . . .

The new unit is a 450-hp. 6-cylinder, 13¼ x 17½ in., 4-cycle, 327-rpm. Diesel engine, built by the Worthington Pump & Machinery Corp., direct connected to an Elliott 300-kw., 80 per cent p.f., 2,400-volt generator wth a direct-coupled 10-kw., 125-volt exciter. The engine is equipped with a Woodward electrical synchronizing governor and the Bosch fuel injection system. In this system, each cylinder is served by an individual fuel pump which injects a measured quantity of fuel oil through the spray nozzle, into the combustion space, at the proper time. The spray nozzle is fitted with a number of very fine holes through which the fuel oil is sprayed in the form of a finely atomized spray, combustion taking place as the oil comes into contact and mixes with the hot compressed air in the cylinder head. This is known as the solid injection system and it eliminates the high-pressure air compressor used with air injection systems. The Woodward governor is an extremely sensitive one, developed for use with the Diesel engine. The governor weights act only to operate a pilot valve, utilizing oil under pressure, which in turn controls the fuel quantity through the action of a servo-motor. The governor is furnished with a load-limiting and indicating device, and, in addition, has an electric synchronizer which can be adjusted manually at the engine or electrically at the switchboard.

Owing to the crowded condition of the room, it was necessary to construct an additional bay to the building to accommodate a portion of the engine. This is shown in the picture reproduced on page 43.

The three-cylinder, air injection Nordberg unit operates on the two-cycle principle, in which there is a power impulse at each stroke. Each cylinder is served by its own constant-stroke fuel pump, the action of the governor causing the pump to by-pass the amount of oil in excess of that required by the load. The correct quantity of fuel oil having been deposited in the injection space, it is blown into the combustion space by a jet of high-pressure air from a three-stage compressor driven off the main crankshaft. Scavenging is accomplished by low-pressure air, delivered from a two-stage compressor also integral with the engine and driven from the main crankshaft.

It is interesting to note that there is a decided trend away from air injection for the smaller sizes of Diesel engines, mechanical or so-called solid injection being used almost exclusively in sizes up to 500 or 600 kw. This does away with the high-pressure air compressor and permits the fuel pump, directly or indirectly, to discharge the measured quantity of oil through the injection nozzle into the combustion space. The air injection systems permit the use of the heavier grades of fuel oil, but there is a tendency towards the use of the lighter gravity oil in the smaller plants. The question of two-stroke cycle as against four-stroke cycle is a much mooted one, with advocates for each, depending upon the angle from which they view the problem.

Auxiliaries for the Diesel plant are perhaps greater in number than for the steam plant and require more care in their selection. They are, however, practically automatic in their operation. They consist of a cooling system for the engine jacket water, usually embracing a cooling tower, heat interchangers or coolers, and circulating pumps for the jacket water and raw water. Where the cooling water is scale-producing there must also be provided some system of water softening. Fuel oil storage tanks, service pumps for transferring the fuel oil, and service tanks and meters are required. For the lubricating oil there must be provided a storage tank, coolers and some form of centrifuge for regular centrifuging of the oil. Oil filters and a distributing pump are usually an integral part of the engine. Indicating or recording pyrometers for the exhaust gases and various temperature indicators and alarms are essential for the intelligent operation of the unit.

Air supply for the engines is first passed through suitable filters and then through an intake silencer of the Maxim, or other, make on its way to the engine cylinders. The exhaust gases pass through a water-jacketed manifold and an exhaust silencer to the atmosphere.

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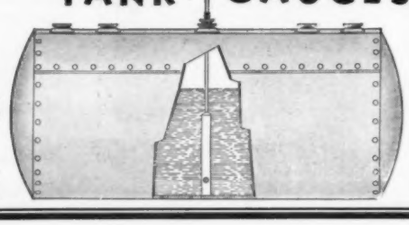

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Lb. fuel per bhp.	.40	.41	.44	.58

The price of 26-36 deg. gravity fuel oil within a reasonable distance of Pittsburgh or Buffalo, varies from 5 to 6 cents per gallon, from which it will be seen that the resulting cost of power, ful fuel only, is between .4 and .5 cent per kilowatt-hour. At seaboard and farther west the cost is proportionally lower.

The lubricating oil consumption is of great importance and one of the main items of expense; the cost being of the order of 50 cents per gallon. Guarantees are usually given as 2,000 rated kilowatt-hours per gallon of oil, but this figure is being bettered in some cases by 100 per cent. A good grade of lubricating oil is of the utmost importance in the operation of the Diesel engine.

The Elliott generators at Ford City are required to operate in parallel with each other and with the gas-engine generators. This they have done very satisfactorily. The operating record of the first generator has been perfect and the owners, therefore, requested that the second generator be an Elliott, if possible. The design of these generators must frequently fit into an existing station where older machines are in service. Each generator must, therefore, to a minor extent, be custom-built so as to fit into the station conditions.

The Borough of Ford City is to be congratulated on its success in generating its own electric power and successfully serving the community for so long a period. The members of the Borough Council who gave no inconsiderable amount of their time and energy to this project deserve the thanks of the community.

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MR. F. M. YOUNG, President of the Young Radiator Company, announces the appointment of Mr. John J. Hilt to the Vice-Presidency in charge of sales, Contract Division, Young Radiator Company.

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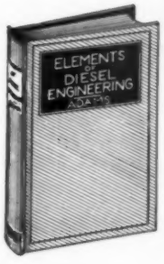

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IT is usual to heat fuel and lubricating oils before centrifugal purification to make the process more thorough and more rapid. Yet a fairly close control over the oil temperature is required in order to avoid difficulties from gas bubbles or even carbonization. The electric heaters so widely used for this purpose consume considerable energy, and it must be subtracted from the useful output of the engine. Here is a means of heating the oil by utilizing waste exhaust gas heat for this purpose. Not that the use of this exhaust gas heat is unusual, but the use of it for direct heating of the oil is novel.

A first reaction to this method might be that the high temperature of the exhaust gases would cause local overheating or scorching and give difficulties, but an essential part of the designs acts to avoid just this, even though the normal automatic temperature control should fail.

The method of operation can perhaps best be understood by studying the drawing shown on page 53. This drawing is out of proportion and out of scale, but it does show all of the essential parts as they are connected together in the actual equipment

First there is the familiar centrifugal purifier with its attached rotary type suction pump marked B in the drawing. The oil to be purified enters the system through the pipe C. The suction pump not only draws the oil from the tank or engine lubricating system as the case may be, but it also circulates the oil through the heater and delivers it to the purifier. The quantity of oil delivered is largely controlled by the by-pass valve D. If this valve is wide open and the shutoff valve in the pipe to the purifier is closed, then all of the oil will be recirculated and none drawn from the source once the circulating system becomes filled. Such a condition would prevail when first starting in order to properly heat the first part of the oil to be purified.

Once the right temperature is reached, the valve to the purifier can be opened, the by-pass valve automatically closing partially. There is thus complete control over the rate of flow through the purifier from zero up to the full capacity of the pump by manipulating this

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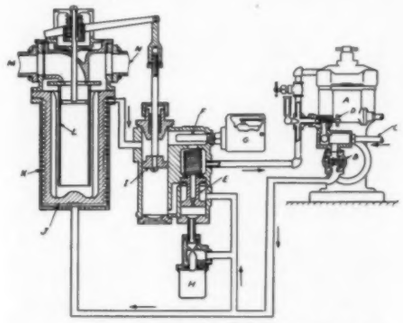
valve. It is important to note that regardless of the quantity of oil delivered to the purifier at any time, there is always the full pump capacity flowing through the heat exchanger.

The heat exchanger assembly includes the exchanger itself, the exhaust gas manifold and valve, and the valve operating mechanism.



Courtesy of Goulds Pumps, Inc.

Exhaust gas heater for heating lubricating oil and fuel oil for centrifugal purification.

Legend

A Centrifugal purifier
B Rotary suction pump
C Oil inlet pipe connection
D Bypass valve
E Piston valve for controlling I
F Thermal element for actuating switch G
G Control switch for actuating solenoid H
H Solenoid for actuating bypass valve
I Piston for operating exhaust gas flow control valve and baffle L
J Heat exchanger casting
K Heat exchanger jacket
L Exhaust gas flow control valve and baffle
M Exhaust gas inlet connection
N Exhaust gas outlet connection

The exchanger J is of cast aluminum with longitudinal ribs inside and a spiral circumferential rib on the outside. The exhaust gases enter at M and flow through the valve and baffle L to flow back along the inside of the exchanger casting. The casing K covers the outside of the exchanger closely and in conjunction with the spiral groove on the exchanger, there is formed a single long passage for the oil flow. The oil enters at the end and leaves at the flange for bolting to the exhaust gas manifold, to enter the valve operating mechanism cylinder.

The heat exchanger has several important design features. The area of the exhaust gas passages, and hence the gas velocity, the area of the oil passage and hence the oil velocity, the areas of the heat transfer surfaces, and the thickness of the casting are all under the control of the designer and are made to suit the

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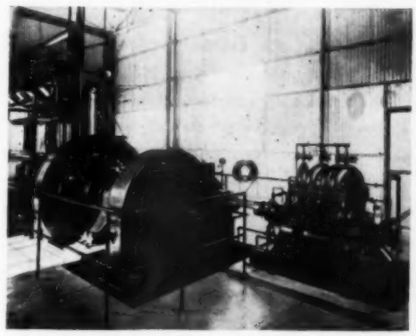

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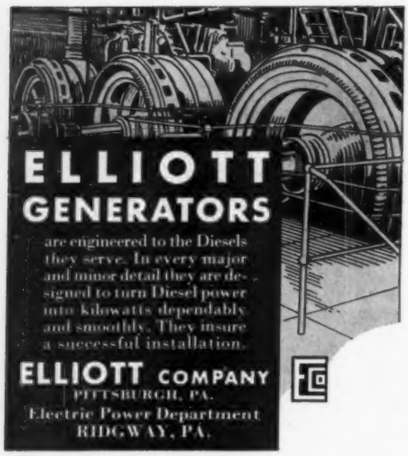
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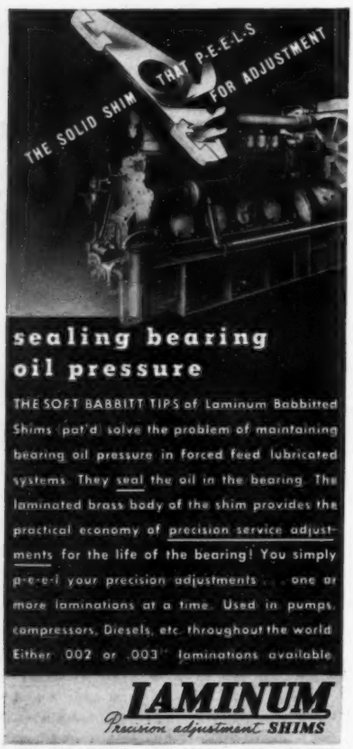
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conditions of installation. The large area of heat transfer surface for the oil along with the positive flow over all of the surface, maintains a low temperature difference between the exchanger surface and the oil with consequent low oil film temperature. The comparatively thick wall of the exchanger gives ample sectional area and this with the high conductivity of the metal allows rapid transfer of heat to all surfaces in contact with the oil, preventing hot spots or cold points. The form of construction permits of proportions which will make the temperature of the exchanger casting low as compared to the gas temperature. The relative temperatures through the exchanger are shown in the diagram. These figures were taken from actual tests. It will be seen that the maximum temperature of the oil film is only a few degrees above the desired temperature of the oil, and local overheating is impossible.

The heat exchanger casting and the jacket are bolted to the gas manifold by flanges. There is thus one gas joint and one oil joint. A leak in either one of them is immediately noticeable. The exchanger and jacket are easily removable without disturbing the exhaust piping. After removal, the parts are fully exposed for inspection and cleaning.

The gas flow control valve consists of a tubular baffle with a flange which fits against the mouth of the gas inlet nozzle when the gas flows through the heat exchanger. When the gas is by-passed, the flange on the end of the control valve fits against the exchanger casting near its outer diameter, closing the gas return passage from the exchanger, and forcing the gas directly out through N. The position of this valve is determined by an automatic temperature control acting through the operating mechanism.

The oil leaving the heater flows around the thermal control element F. If the oil is below the temperature for which this element is set, the element F closes the electrical switch G, which operates the solenoid H, which opens the by-pass valve and permits the oil pressure from the pump to act on the piston valve E. Due to the resistance to flow through the heat exchanger, the pressure of the oil flowing from the pump is appreciably greater than that of the oil returning from the exchanger. Therefore the high pressure oil acting on the bottom of the piston valve will overcome the pressure on the top plus the spring load and the valve will take the position shown uncovering the port into the cylinder alongside. This permits the high pressure oil to enter under the piston I, overcoming the resistance of the low

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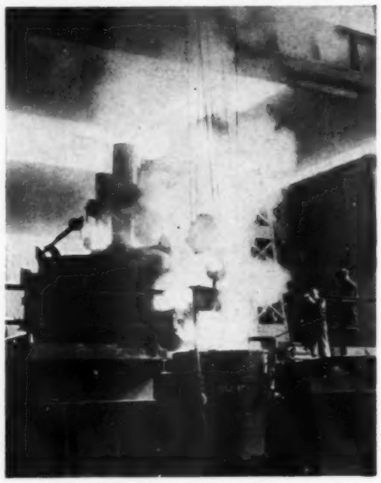

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pressure oil on top and the spring on the stem of the gas flow control valve. Thus the gas will flow through the heat exchanger and the oil will be heated.

As soon as the temperature of the oil coming from the exchanger exceeds that for which the thermal element is set, the switch G opens, the solenoid valve H closes, the high pressure oil under the piston valve E escapes through the hole in the stem to the outflowing oil, the spring forces the piston valve back to open the cylinder for piston I to the low pressure outflowing oil, and the spring on the gas flow control valve forces it into the by-pass position. Thus the oil flowing from the heat exchanger is automatically maintained at almost a constant temperature regardless of variations in rate of oil delivery to the purifier or changes in exhaust gas temperature.

The hole in the stem of the piston valve E does by-pass the heater, but the hole is small and the quantity of oil by-passed is small, so that it has no effect on the action except when acting as a leak off for actuating the piston valve.

Not only is there a steady flow of oil through the heat exchanger all of the time while it is in operation, but there is also a steady flow of exhaust gas at least through the manifold. In other words, all parts maintain their normal operating temperatures at all times, thus avoiding temperature changes which might bring condensation and corrosion.

The construction incorporates certain safety features by automatically returning the gas flow control valve to the non-heating position when there is a break in the electric current, or in case of failure of the oil flow. The former closes the solenoid by-pass valve H, and the latter releases the pressure back of the piston I. In summary, here is a heater for preparing lubricating or fuel oil for proper purification which utilizes the waste exhaust gas heat and which is automatic and safe in operation. The apparatus is compact and there is no intermediate heat carrier other than the metallic wall of the exchanger. There is no local heating of the oil greatly in excess of the average resulting oil temperature. The gas and oil passages are readily and easily cleaned.

EARTHWORM TRACTOR MOVIE

As stated in our July issue, the famous series of stories by William Hazlett Upson which have appeared over several years in the *Saturday Evening Post* have now been made into a moving picture by Warner Bros. "Earthworm Tractors" is the name of the picture, and it is now being shown in moving picture theatres throughout the country.

The series of hair-raising and impromptu tractor demonstrations that mark the progress of the plot, eventually win the girl and a sizable tractor order from her father. And while Brown enacts his role of "natural born salesman," the tractors are proving themselves able performers, too. All tractors in the picture are "Caterpillar" Diesels, and during the filming, the Caterpillar Tractor Co. plant at Peoria, Ill., was taken over by Warner Bros. cameramen for days.

Readers of DIESEL PROGRESS will find this picture well worth seeing. It is really funny.

DIESEL PROGRESS

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SCHWANHAUSSER HEADS BUFFALO CHAMBER OF COMMERCE

EDWIN J. SCHWANHAUSSER has been elected President of the Buffalo Chamber of Commerce succeeding Smith M. Flickinger. Robert F. Hicks has been elected first vice-president; Harry A. Howard, second vice-president; William C. Baird Hershey, treasurer; Samuel B. Botsford is executive vice-president.

President Schwanhausser is manager of the Buffalo Works of Worthington Pump and Machinery Corporation. He received his M.E. degree at Stevens Institute of Technology and is a member of the American Society of Mechanical Engineers. He is chairman of the executive committee of Interallied Foundries of New York State and a member of the State Advisory Council for vocational and apprentice training for the Board of Regents. He is a member of the Buffalo Athletic Club and the Park Country Club.

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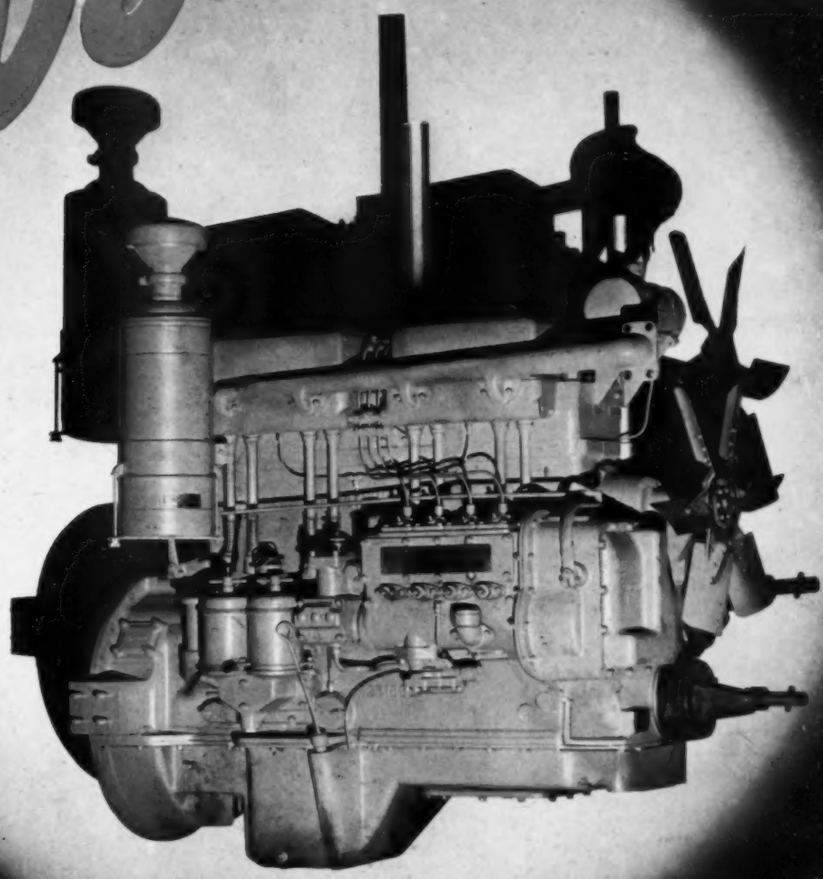

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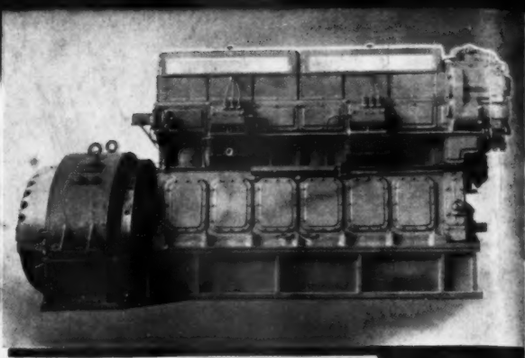

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